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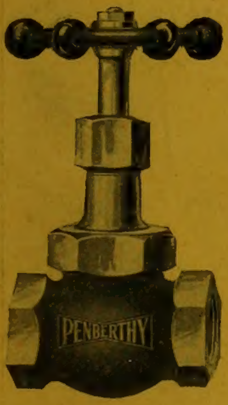
THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.
MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. WINNIPEG: 34 Royal Bank Bldg.
LONDON, ENG.: 88 Fleet St. E.C.

Vol. VII. Publication Office, Toronto—January, 1914 No. 1

TRADE PENBERTHY MARK



Regrinding Brass Valves
"THE ALL QUALITY LINE"
The Finest Valve on the Market

Some Sound Practical Reasons Why the Penberthy Valve is Superior

The bonnet is secured to body by heavy union ring, and the threads on bonnet end of body being on outside makes the above connection rigid, steam tight and non-corrosive, and permits free accessibility to valve at any time without strain or injury to same.

The regrinding feature of the Penberthy Valve with metal to metal seats, is much superior to, and more economical than, the composition disc valve, which type is only recommended for ordinary steam pressure and which necessitates the frequent renewing of discs at extra expense.

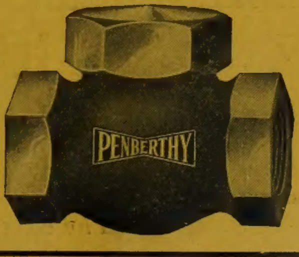
The regrinding feature of the Penberthy Valve entirely eliminates the necessity of renewing discs and permits both the seat of body and seat of disc to be reground together quickly and with no extra expense.

The metal is of the best quality and is so distributed that the parts subjected to the greatest strain and wear have proportionately heavier walls.

The design, workmanship and finish is not equalled by any other valve on the market.

"Specify Penberthy Regrinding Valves"

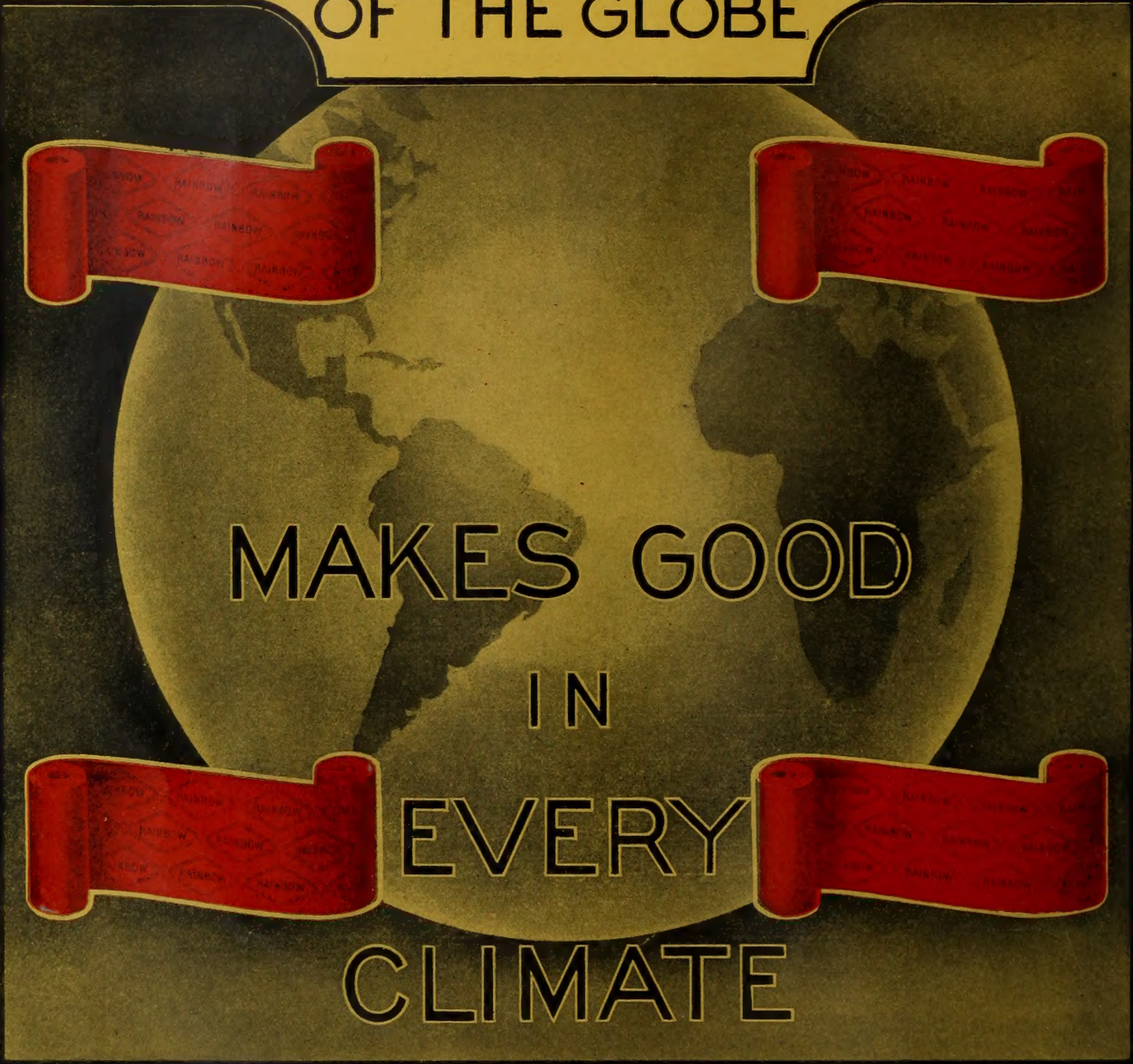
They will add to and increase the efficiency, economy and prosperity of every building or power plant in which they are installed.



Approved by and Registered in Ontario and the Western Provinces for Steam Pressures as high as 200 lbs.

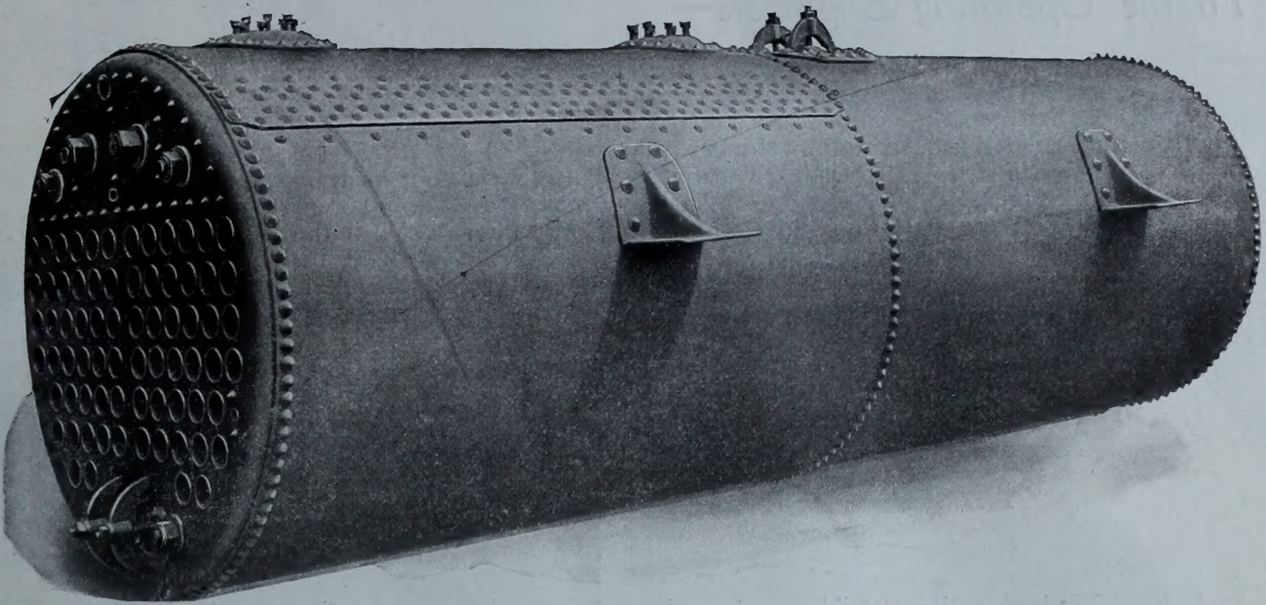
MFG. BY
Penberthy Injector Co., Limited
WINDSOR, ONT.

RAINBOW PACKING
IS USED IN THE FOUR CORNERS
OF THE GLOBE



MANUFACTURED EXCLUSIVELY BY
PEERLESS RUBBER MANUFACTURING COMPANY
16 WARREN ST., NEW YORK.

FOR SALE EVERYWHERE



Waterous Boilers

For Power and Heating Purposes

If you want **boiler service** and **boiler satisfaction** in your power plant, install WATEROUS HORIZONTAL TUBULAR BOILERS.

They are economical of fuel—carry a big reserve steam pressure for use in emergencies—can be used with hard and dirty water and they are easily cleaned and taken care of.

We build them in sizes from 40" x 10' to 72" x 18' for all Provinces. If we cannot supply you at once from stock we can turn out your order in quick time.

Waterous Boilers cost little new—up-keep expenses are practically negligible. Let us quote prices and delivery on the next one you buy.

All the Steam
You Want—
All the Time

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA

To the Operating Engineers—

We want to thank you very heartily for the support that you have given the Dunham goods during the year just closed.

It has been the aim of this Company to make the very best Radiator Trap that modern genius, labor and machinery can produce. A trap that would eliminate the numerous troubles experienced in some vacuum systems of heating. A trap which will be accepted by the engineers strictly upon its merits, because you are the men who use these specialties and are in a position to know which is the best.

The unanimous expression of satisfaction with the Dunham Trap from Operating Engineers over Canada, strongly indicates that the Dunham Trap is doing what we claim for it and that it makes intimate and lasting friends with the engineers who have taken the trouble to use it.

We want your liberal support during the new year of 1914, and we promise to give you better Dunham Traps than ever before, and you will, by using Dunham Traps, fill several Cups of Joy and Happiness to overflowing.

Your Own. By eliminating troubles and complaints from unsatisfactory heating systems.
Your Boss. By saving many dollars from the coal-pile through economy of the Dunham System.
Ourselves. By adding to our circle of friends, profitable and satisfied customers.

We have a liberal trial offer to make you, whereby you may become the better acquainted with the Dunham Trap. Write us.

Yours for better service in consideration of your business, we are,

Yours very truly,

C. A. DUNHAM CO., Ltd., TORONTO, ONT.

Halifax Montreal Winnipeg Vancouver Calgary Ft. William

Frost King

Babbitt Metal

Is the result of 35 YEARS' EXPERIENCE in metal mixing and we believe it is absolutety perfect.

For high-speed machinery and engine work it is without an equal. It is specially designed for Saw Mills, Planing Mills, Threshing Engines, Traction Engines, Pumps, Rolling Mills, and Pulp Machinery, and all classes of stationary engines.

If your dealer does not stock "FROST KING" write us and we will take pleasure in making you a shipment of a 25-pound box.

OUR MIXED METAL SALES AMOUNT TO $5,000,000 ANNUALLY.

Hoyt Metal Company, Toronto, Ont.

FACTORY AND OFFICE :—Eastern Avenue and Lewis Street

New York, N.Y. London, Eng. St. Louis, Mo.

JENCKES

BOILERS

Will

Minimize Your Stoppage for Repairs

HORIZONTAL TUBULAR

VERTICAL TUBULAR

LOCOMOTIVE TYPES

HEATING BOILERS

Jenckes Boilers are built to stand severe service.

Flange quality steel, conforming to Manufacturers' Standard Specification, is used in sheet and heads. The tubes are lap-welded steel of standard gauge and make; the rivets of special quality rivet steel, and the stays of steel, without welds.

Jenckes Boilers are built to conform with the various provincial inspection acts—every one is tested under high pressure before leaving works.

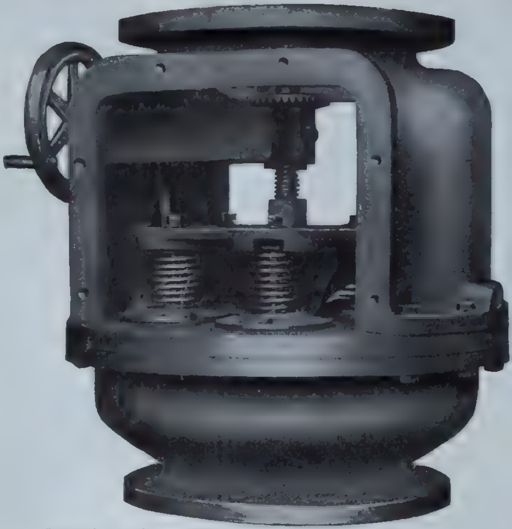
We will take pleasure in getting you in touch with users. Why not benefit by their experience?

ASK FOR CATALOG.

The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Cobalt
South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE.
ST. CATHARINES, ONT.



Interior view of Cochrane Multiport Safety Exhaust Outlet Valve (vertical type)

REMEMBER THE WORD

"MULTIPORT"

WHEN YOU WANT A FIRST-CLASS BACK PRESSURE VALVE

The Cochrane Multiport Safety Exhaust Outlet Valve is called a "Multiport" because it contains several small disks instead of one large disk, each fitted with its own independent spring and dash pot.

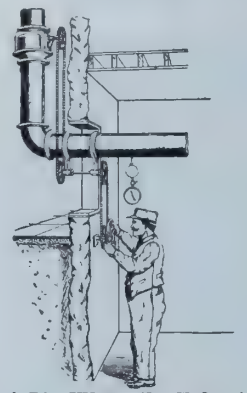
There are several reasons for having a number of disks instead of one.

(a) The chances of all disks becoming jammed or stuck at once is infinitesimal.

(b) The small disks are lighter and require less travel, hence less hammering of the valve face and seat.

(c) Small valves are less liable to leak, and are more easily ground to their seats.

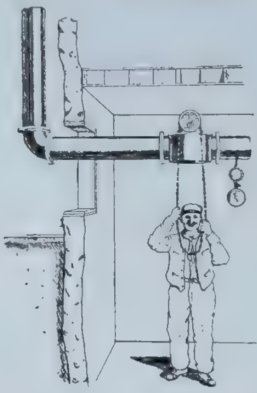
(d) The small disks are easily removable through hand-holes in the casing.



A Good Rig Where the Valve is Outdoors or at a distance.

With the Cochrane Multiport **you can easily modify the back-pressure** as required to meet the heating requirements at different periods during the day, by raising or lowering the pressure plate which bears upon the springs, holding the disks to their seats. This pressure plate is operated by a hand-wheel on the outside of the casing, or from a distance, by means of chains, rods, hydraulic pressure, electric motor, etc.

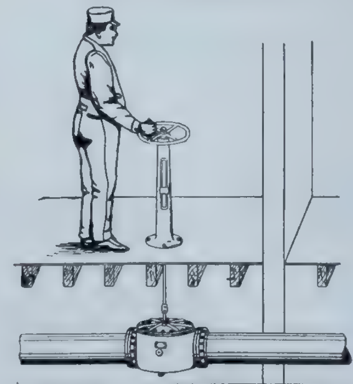
Cochrane Multiports are made not only for back-pressure service, but also for vacuum service to protect condensers, in which case the disks are water-sealed.



Showing What a Snap It Is to Change the Back Pressure with a Cochrane Multiport.

The Cochrane Flow Valve is indispensable wherever mixed-flow turbines are installed, in order to prevent vacuum from the turbine casing backing up into the engine exhaust line and drawing in air through leaks and through piston rod and valve-stem packings. Where bleeder turbines are installed, a Cochrane Multiport should be used as a check valve to prevent live steam, which may be supplemented to the low-pressure steam-utilizing system, from flowing back into the turbine and overspeeding the latter during periods of light load.

For the latest ideas on back pressure valves, also information on the effect of back pressure on steam consumption of engines, send for our booklet, "The Evolution of the Cochrane Multiport," No. 15-V.

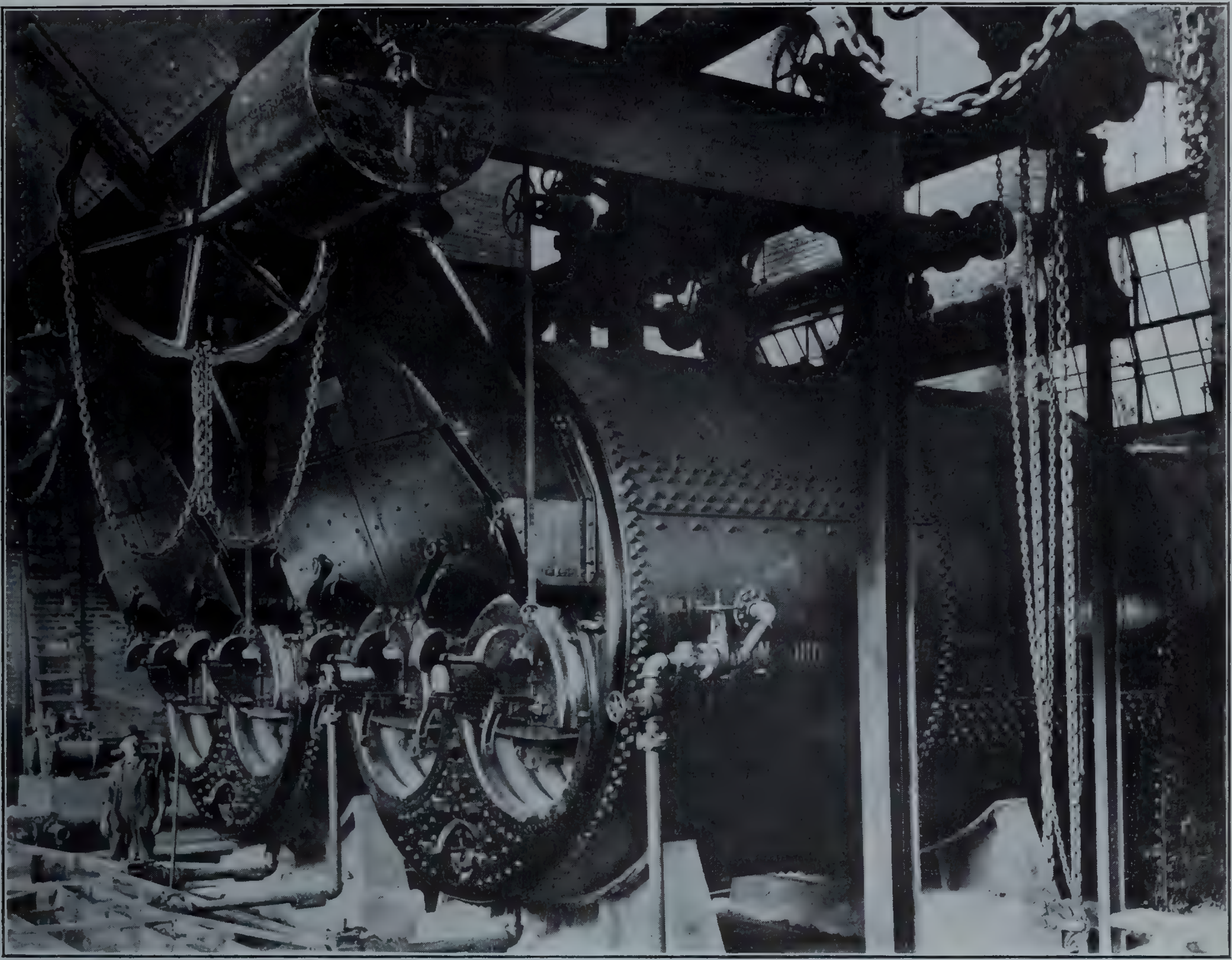


A Simple Rig for Operating Valves Placed Beneath Floors.

CANADIAN ALLIS-CHALMERS, LIMITED

Manufacturers of Air Compressors, Boilers, Cement Making Machinery, Concrete Mixers, Flour Mill Machinery, Gas Engines, Hoisting Engines, Hydraulic Machinery, Locomotives, Ornamental Metal Work, Rock Crushers, Rock Drills, Saw Mill Machinery, Steam Pumps, Steam Specialties, Steam Shovels, Steam Turbines, Structural Steel, Transmission Machinery, Turbine Pumps, Water Wheels, Mining and Crushing Machinery.

Head Office: TORONTO. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.



REPEAT ORDERS TESTIFY

to the reputation that "**Polson**" **Boilers** have gained for correctness of design, construction and general all-round efficiency; to the number of satisfied users who are content to put their steam-raising problems up to the Polson Iron Works; to the high esteem in which they are held by engineers all over the country.

These two boilers were built to fill a repeat order from the Consumers' Gas Company, Toronto. They are of the return-tubular dry back type, each 11 ft. 6 inches diameter, and 15 ft. long. They are fitted with Morrison Furnaces and Adamson Furnaces with Galloway Tubes.

How about your boiler problems? We can give you the same service.

Polson Iron Works, Limited

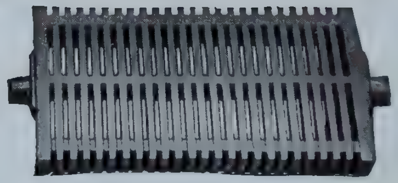
Toronto, Ontario

Representatives in Canada for

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, Eng., Marine Motors

"THE Cyclone"

Shaking and Dumping Grate Bar



Efficiency

demands that you burn your fuel as completely as possible, that you convert a high percentage of the heat units contained in the coal into useful work.

The "Cyclone" because of the large draught area it gives—over 60% of grate area—because the shaking mechanism allows the fire to be kept clean and bright and the bars free from clinkers, burns any fuel in such a manner as to produce the highest thermal efficiency possible with that particular grade.

And the positive locking mechanism keeps the bars firmly in place, yet allows of their being readily agitated or the fire easily dumped.

Next time your boiler needs a new set of bars install a "Cyclone" Grate, and see what a big slice in the coal bill the "Cyclone" will make. But, be sure you specify the "Cyclone" and get the "Cyclone," as we are constantly being flattered by being imitated.

So now—before you forget it—drop us a line, and let us tell you what some of its users have to say.

The Canadian Steam Boiler Equipment Co., Limited

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: TORONTO, CANADA

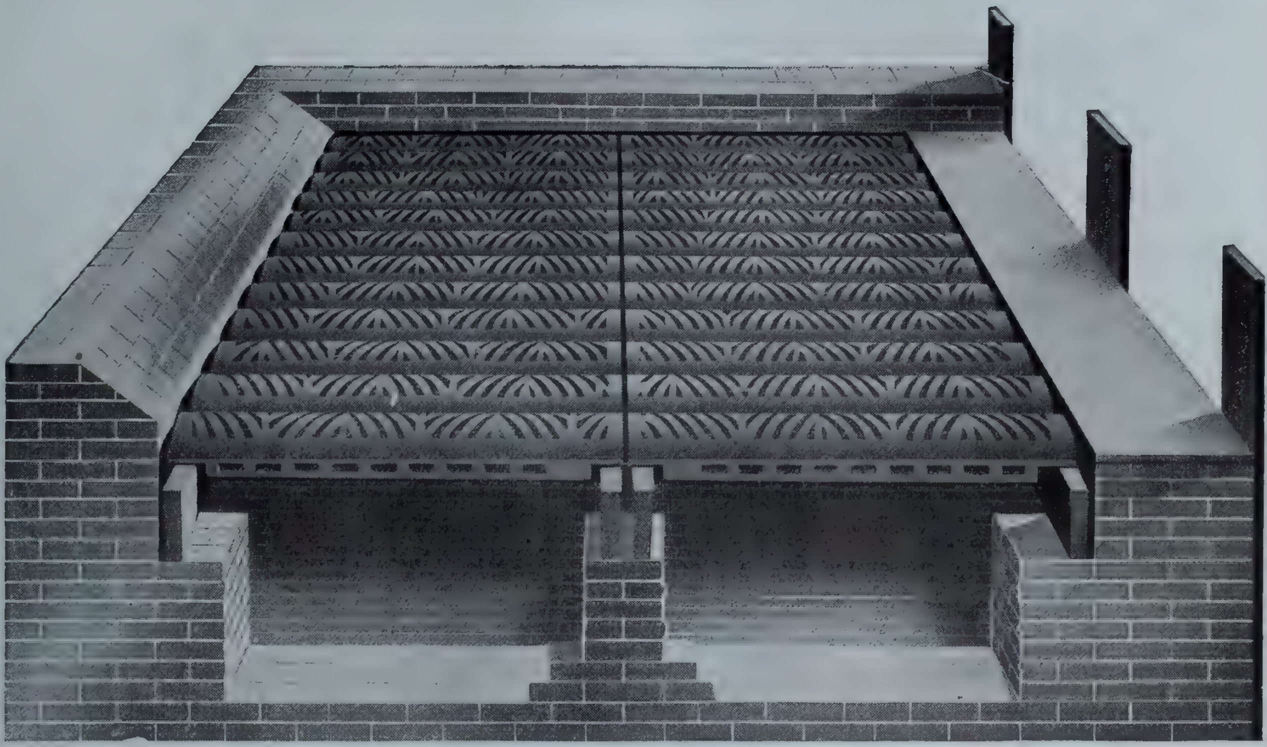
AGENTS

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS— PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

Stop Blow-outs and Leaks in Pipe Lines by Using

GOETZE No. 2 ELASTIC GASKETS

If you start right now to renew with No. 2 ELASTIC GASKETS, you can steadily reduce your renewals until you have brought them almost to the vanishing point.

This is not a mere "claim"—it is backed up by a *guarantee*—in fact the strongest guarantee ever made by a gasket manufacturer.

Think what it means to re-gasket a joint so it will *keep tight for years,* instead of days or weeks. Think of the saving resulting in gasket costs, labor and shut-downs.

What No. 2 Elastic Gaskets Will Do

No. 2 Elastic Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight. Prevent leaks, blow outs and shut-downs. Will practically eliminate renewal expense for gaskets.

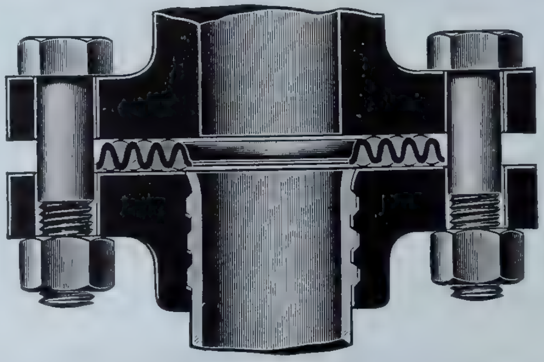
No. 2 Elastic Gaskets are for high pressure and super-heated steam lines, but owing to their indestructible nature, are equally adapted to *any and every condition* about a factory, mill or refinery.

The No. 2 Elastic Guaranteed

Every No. 2 Elastic Gasket is Guaranteed for 5 Years' Continual Service in the Same Joint

There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every No. 2 Gasket whether bought direct from us or through a dealer.

How No. 2 Elastic Gaskets are Made



These Gaskets are made of corrugated copper with asbestos lining No. 2. The corrugations allow for expansion and contraction of the pipes, while the asbestos, being forced into the pores of the metals in the flanged surface by the "squeeze" and the constant pressure of the corrugations beneath it, holds securely against the highest pressures.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

ST. JOHN, N.B.

BRANCHES AT

MONTREAL
112 St. Peter St.

TORONTO
Mills Bros.,
809 Lumsden Bldg

WINNIPEG
C. E. Chown,
425 Henry Ave.

LETHBRIDGE, Alta.
J. B. Turney & Co.

VANCOUVER
c/o A. O. Campbell,
626 Pender St.

MANUFACTURED BY

Goetze Gasket & Packing Co., New Brunswick, N.J.

"TESTED PACKINGS FOR EVERY PURPOSE"

This pamphlet is an authentic text-book—a complete illustrated guide—to standard lines of tested packings.

We shall be glad to send you a copy, gratis.

Canadian Consolidated Rubber Co., Ltd.

MONTREAL

Please use this coupon ☛

Canadian
Consolidated
Rubber Co., Ltd.,
Montreal.

Gentlemen:

Please send me a complimentary copy of "Tested Packings for Every Purpose."

Name ....

Address ....

....

P

It is the same Old Game

For the "victim" the result is always the same, whether he gamble on the "shell game" or on imitations of the REAL Daniel's P. P. P. Rod Packing.

The engineer who takes a "chance" on imitations of P. P. P. makes a whole lot of trouble for himself; the bother of a "blowing," leaking engine and its frequent repacking at night or on Sundays. The dealer, as a rule, knows little about the practical values of packings and, naturally, sells the kinds that offer the largest and most frequent profits.

Neither the engineer who buys the substitutes for P. P. P. or the dealer who sells them is dishonest—they simply do not know what experience would show them; that the GENUINE P. P. P. gives the longest service and saves hundreds of dollars, yearly, on the coal pile.

DANIEL'S ROD PACKING

P. P. P.

COIL, SPIRAL, RING

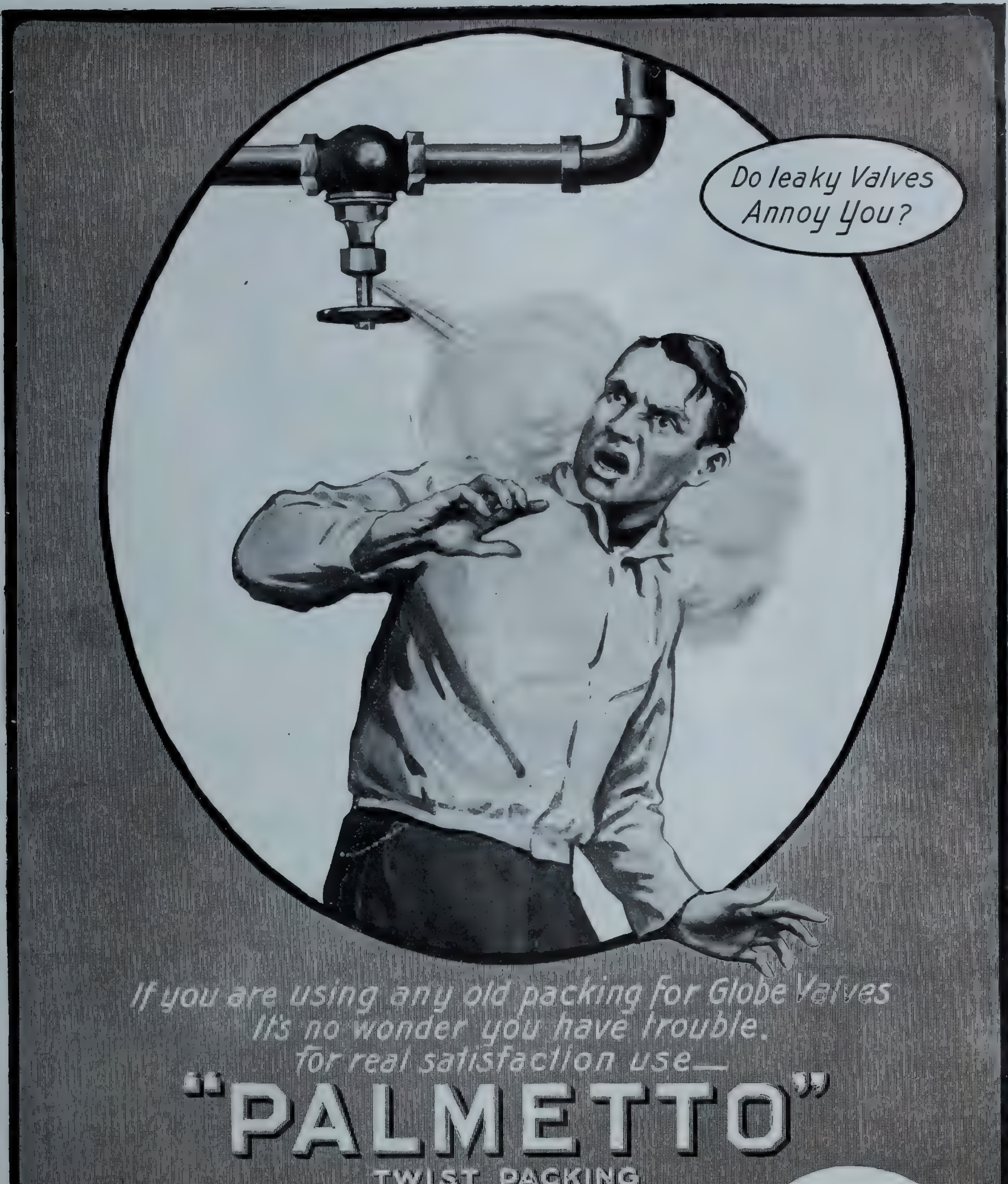
Daniel's is the ORIGINAL "sliding-wedge" and "compressible-cushion" packing, and is the only one whose claims are backed with SCIENTIFIC PROOF.

Others may copy the form of P. P. P. or follow our advertising, BUT P. P. P. is the only one that does what we PROVE P. P. P. does.

Insist on getting the box with the big RED D (see illustration) and the signature of C. A. Daniel.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, Pa., U.S.A.
629 Market St.


Do leaky Valves Annoy You?

If you are using any old packing for Globe Valves
It's no wonder you have trouble.
for real satisfaction use—

"PALMETTO"

TWIST PACKING

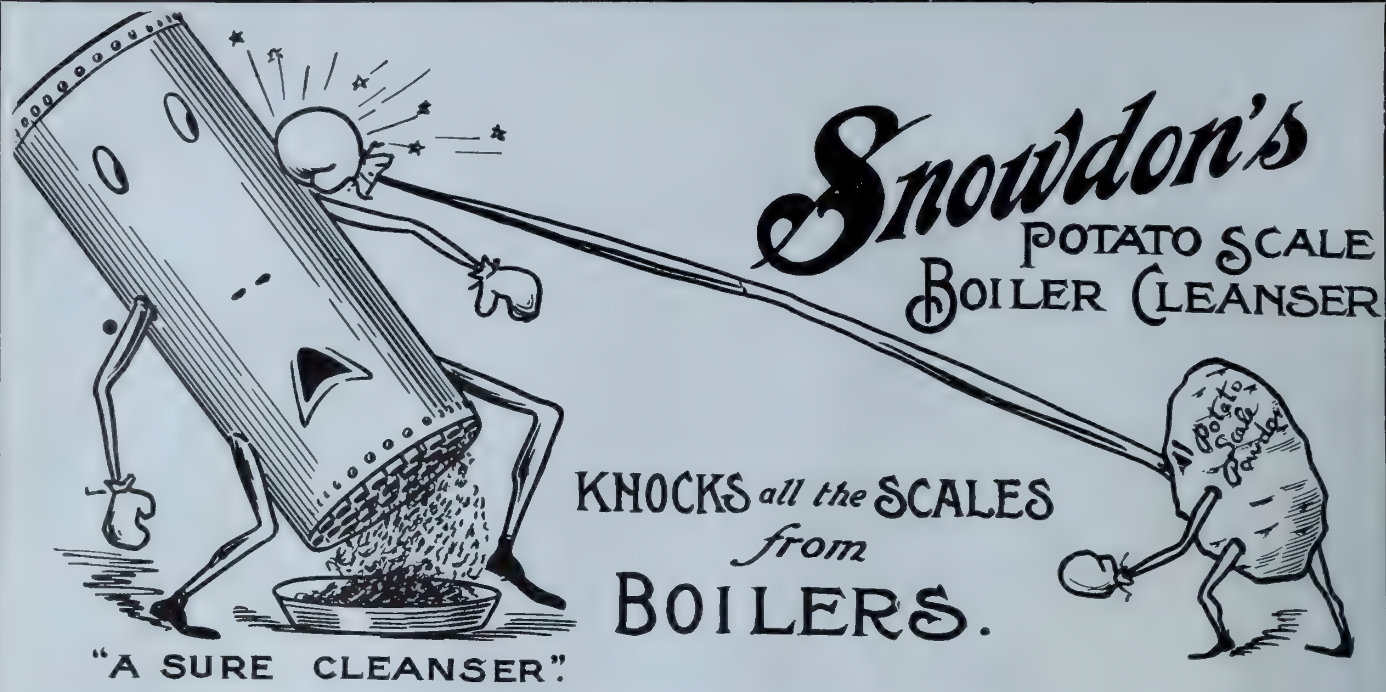
It's own lubricant keeps it soft and pliable in service and the Stem so nicely lubricated, the hand wheel turns easily.
Keeps the Valves from leaking

A real advantage.

Any size valve can be packed from one spool
You just unstrand it.

SEND FOR FREE SAMPLE

GREENE TWEED & CO.
SOLE MANUFACTURERS
109 DUANE ST., NEW YORK.



Positively keeps your boiler tubes FREE from SCALE, prevents pitting, corrosion, foaming, etc.

Potato Scale Powder Boiler Compound has proven itself to be successful everywhere.

Snowden's Potato Scale Boiler Cleanser saves

Money and Fuel

by its adaptability and readiness for instant use. *Let us send you a trial keg.* Your money back, if not satisfactory.

Branches:
Vancouver
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C. C. SNOWDON

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

1810 - 1840 11th STREET EAST (Corner Burns Avenue)
CALGARY, ALBERTA

PERSONAL

If the Engineer who spent all last year fighting leaky joints with ordinary sheet packing will write to

THE GARLOCK PACKING COMPANY

he'll soon know all about how to avoid future troubles along this line.

By Using

Garlock Palmyra Red Sheet Packing

STYLE 22

he will not be taking chances with a packing which **may** do the work.

There is no question about the merits of **Style 22.** It does the work at all times, because it is made of the highest grade rubber, compounded in such a way as to give it strength and reliability.

Write for a Sample to-day.

The Garlock Packing Company

Hamilton, Ontario

MONTREAL TORONTO WINNIPEG VANCOUVER CALGARY

"Pioneers in the Packing Business"—and Specialists

JENKINS BROS.'

TYPE "K" IRON-BODY GATE VALVES

All Sizes and Styles

Stocked by Dealers Everywhere

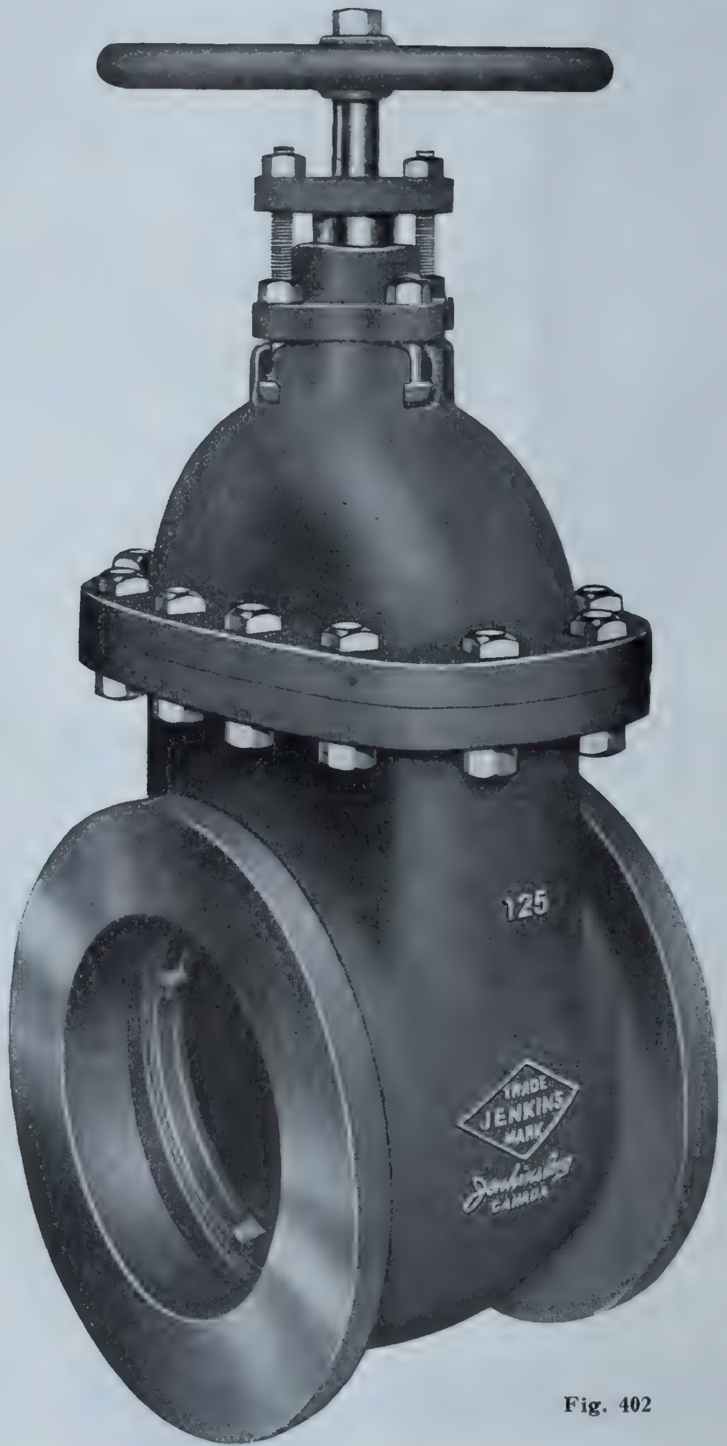


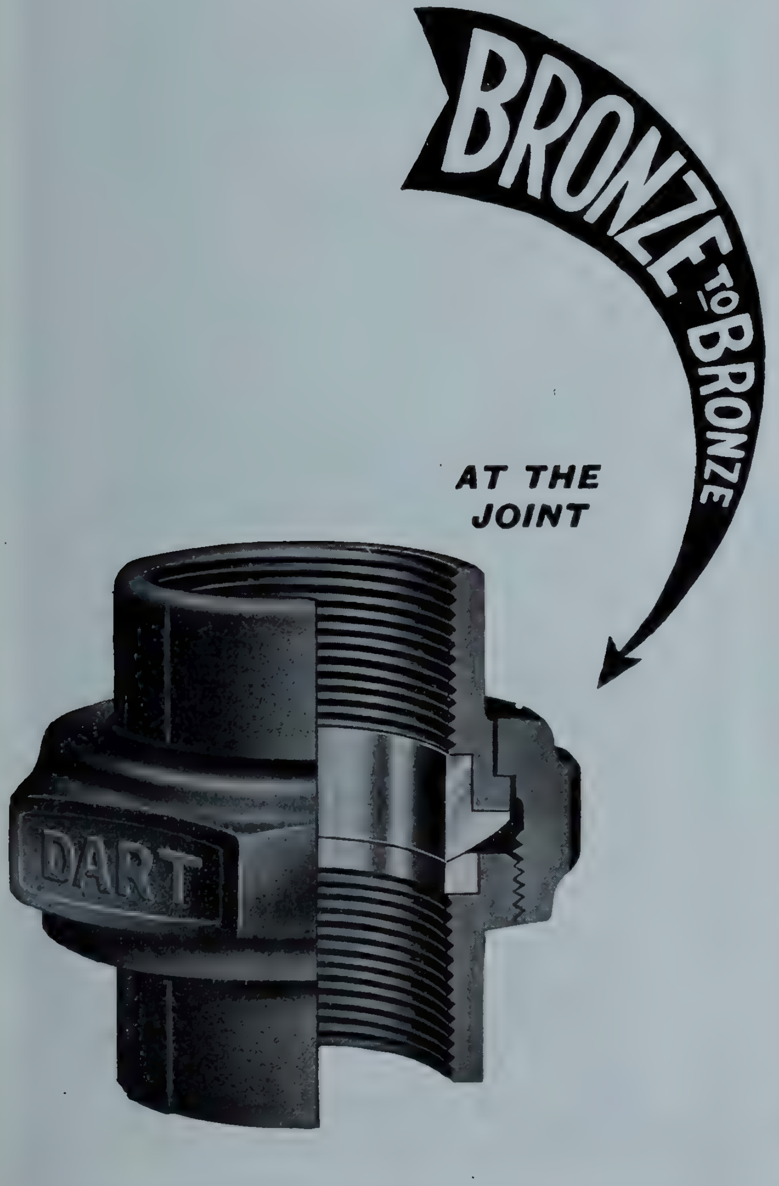
Fig. 402

Catalogue mailed free upon request.

JENKINS BROS., Limited

103 St. Remi Street MONTREAL

Make Permanently Tight Joints



Have Heavy Iron Parts that Cannot Stretch or Pull Apart.

Bronze on Each Face of the Joint Makes Corrosion Impossible.

The bronze to bronze ball-shaped seat of the Dart Union allows for a perfect and **practically everlasting joint** between pipes, whether they are in or out of line.

All that is necessary is to draw the two faces together and you have a joint that defies time, pressure, corrosion, vibration, expansion and contraction, yet may be easily unjointed and jointed as often as you wish.

All Dart Unions have the trade-mark as shown on the cut. We will promptly replace two for one any Dart Union that is found defective.

Jobbers from coast to coast sell them.

DART UNION CO., LTD., TORONTO

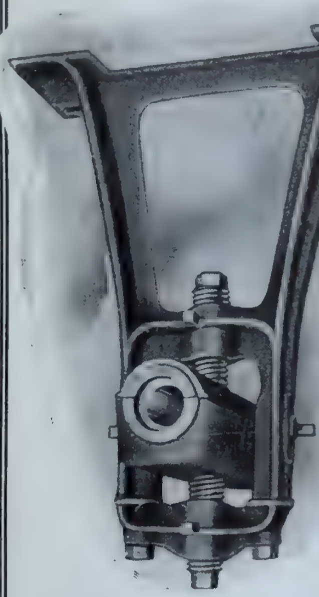
ELMIRA

Ball & Socket HANGERS

For MAXIMUM Service

Wood Split PULLEY

AND BIG REDUCTION IN POWER TRANSMISSION COST



The "Elmira" Ball and Socket Hanger

is exceptionally strong and heavy. In this hanger a union system of oiling is employed, a combination of centrifugal and capillary attraction, effected by tempered steel rings and woven cotton distribution of lubricant, and precludes the slightest possibility of "Dry Bearings" so long as any oil remains in the reservoir or dry chamber, one filling of which should last from six to twelve months.

The "Elmira" Wood Split Pulley

You can use an "Elmira" Pulley any place that a leather belt will give satisfaction, and know that what any good pulley will do, it will do, and more.

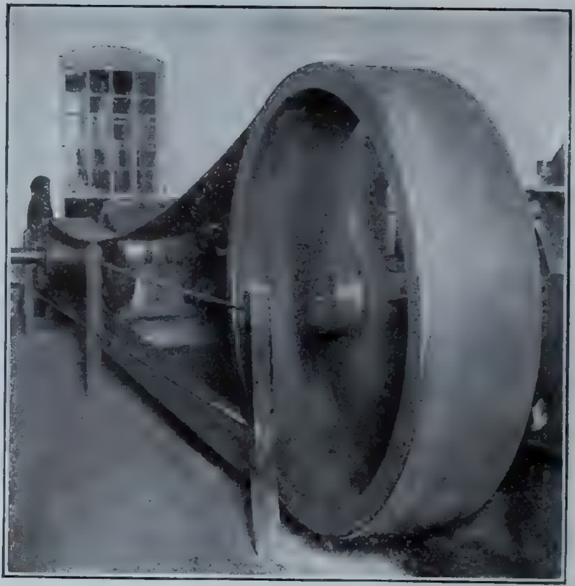
This pulley stands the hardest and most severe conditions. It is nailed throughout. The arms are tenoned into rim and dowelled there.

Absolutely guaranteed.

It will be much to your interest to let us furnish you with our illustrated catalog. Write for it to-day.

Large and complete stocks carried at Elmira and by The A. M. Ellicott Co., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Ltd.
ELMIRA, CANADA



The belt in this photograph is 3-ply;

it is transmitting 220 h.p.; is under a tension of over 1445 pounds on the pulling side;

and yet

THE TOP SIDE RUNS SLACK

Cling-Surface Does It

When this belt was photographed (in the plant of the Wilkes-Barre Light Co., Wilkes-Barre, Pa.), it was pulling 220 horse power. Looks as though it was pulling nothing, doesn't it? Increase the load to 268 h.p., the rated capacity of the generator, or even higher, and it will act equally well—makes no difference to a Cling-Surface-treated belt—the greater the load the further it lies down on the pulley and pulls, for it is the contact that counts. Treated with Cling-Surface a belt can't slip, especially if it is provided with a fairly liberal arc of pulley contact as above.

The belt isn't made the least bit sticky, but rendered pliable and slipless by the penetrating and lubricating action of Cling-Surface.

The speed of the above flywheel is 240 r.p.m. and its diameter is 80 inches. The generator is 200 kw., 3 phase, 2300 volt, 60 cycle, and its pulley is 32 inches in diameter. Distance between centres 24 feet. When the belt was new it was not treated for three months. It became oily and dirty and began slipping. Even the tightener would not prevent slip. Then Cling-Surface treatment began, and they write: "Followed Cling-Surface instructions on first application and since then gave an occasional application with brush. Result—no trouble whatever on account of belting." We have thousands of installations doing equally as well.

Send your trial order now. We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo N Y

64

Of Human Interest

There is often more to our advertisements than the mere dry, technical side. There is food for the imagination in such letters as the one we recently published from an Engineer in far-off fever-stricken Africa, where, like as not, he met, as he was going in, the coffin of his predecessor as it was coming out; or the letter from the Engineer describing his anxiety as he watched the crank pin of a racing engine in a gale off a lea shore in the Bay of Biscay. Below we give an interesting letter from Arica, Chili. These letters, coming from the remotest parts of the earth as well as many nearby, all gratefully acknowledge that Magnolia Metal stands up to the scratch where other babbitts go down, and its value is sometimes almost beyond computation.

FERROCARRIL LONGITUDINAL DE CHILE SECCION NORTE.
Contratistas, Macdonald, Gibbs & MacDougall (Chile)., Arica, 5 Apr., 1913.

Gentlemen:—I have great pleasure in stating to you the result of my experience in different classes of metal that I have tested on our engines here; which, considering the difficult work that I have to do, is pleasing. The great trouble on our rack loco engines was that the wear on the working parts was so much that they were continually in the shop; now, you can understand that on construction work to have your engines lying in the shop it was up to the shop, and the Manager saw it too. I tried babbitt true metal, solid brasses, other classes of metal, but not until I met your Magnolia did I get the relief that was my aim. On this road where the rain has not fallen for more than human agency can remember, the dust is so great that it almost beats the Sahara; and for your metal to show the road to other makers as regards economy in cost in wearing ability, therefore most reliable, is, I think, a splendid recommendation to other engineers who may be in need of a good metal, to whom reliability is everything.

Yours faithfully, (Signed) H. S. THOMAS, Engr.

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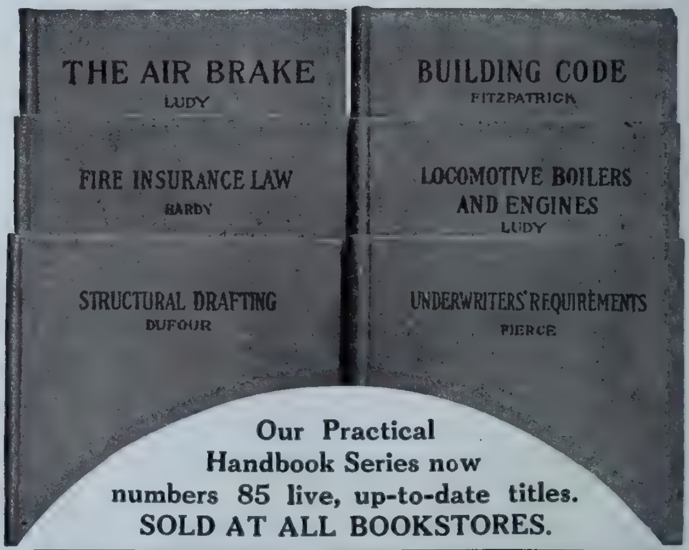

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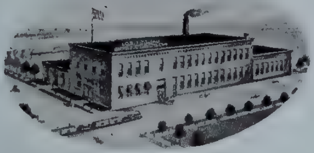
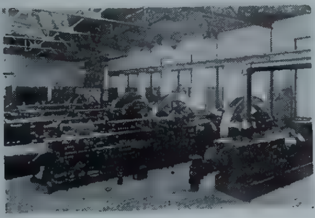
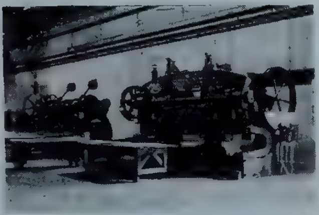

Canadian Factory, Toronto, Ont.


The Power Plant, Equipped with a complete Bowser Oiling System.

View of Heavy Tank Shop, showing 10,000 gallon Tank under construction.


Corner of Light Tank Shop, showing two of our Immense Squaring Shears.

Machine Room for making our Brass Fittings and Valves.

Laboratory for Testing Samples.

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From the foundation of the Company we have been governed by the "SERVICE IDEA." The public's discrimination, intelligence and appreciation of true values have not only been understood, but have been the chief force in shaping this business. Sound values are so adjusted to reasonable prices that there is bound to be a saving of money, true value considered.

The BOWSER was the first long distance, self-measuring oil storage equipment ever made. Twenty-eight years ago, S. F. Bowser, President of S. F. Bowser & Company, Inc., invented and patented the first BOWSER; built the first of the long line of BOWSER SYSTEMS that have meant so much to every individual, firm and dealer having occasion to store oil of any kind.

To-day the Company occupies over 8 acres of floor space, employs nearly 1,000 men in the factory the year round, has over 450 specialty salesmen on the road, 200 or more in the office and its equipment is sold through Branch Offices located in almost all foreign countries.

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for the far-seeing man who is looking for big, though sure, returns on his outlay. It is a dividend producer rather than a yearly depreciating fixture. It is an insurance policy with only one premium—it soon begins to pay premium.

It means a system which will properly store and accurately distribute the liquids in any plant, whether it be large or small.

It means lower production costs and economy from every standpoint.

It means increased working capacity and all-round satisfaction in the beginning as well as in the ultimate.

Is it any wonder that there are to-day over a million satisfied users in every class of business who daily testify by their enthusiastic use of Bowser equipment what BOWSER SERVICE has done for them?

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An inquiry costs little, does not obligate you in the least and may be the means of saving you and your stockholders many dollars now unknowingly wasted.

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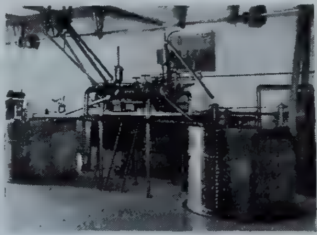
Established 1885.

SOME INSTALLATIONS

Battery Equipment, Bates Mfg. Co., Lewiston, Me.

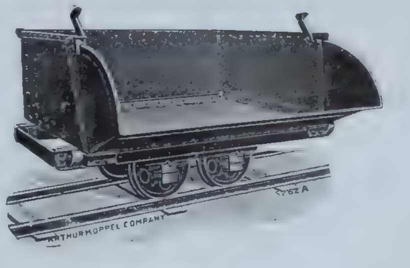
Hand and Power Pumps, Indiana Steel Co., Gary, Ind.

Filtering. National Cash Register Co., Dayton, Ohio.


Registering Measures, Dearborn Drug & Chemical Co., Chicago, Ill.

Oil Reclaiming System Timken Roller Bearing Co., Canton, Ohio.

Power Pumps, C. M. & St. Paul R. R., Miles, Mont.



How to Charge Furnaces Economically

A very important factor in the problem of keeping a constant supply of power is that of how to stoke furnaces efficiently. We are selling agents for a system of conveying coal and for charging furnaces in boiler rooms which requires very little labor and is practically indestructible. This system consists of the well known Koppel Cast Plate Track and Charging Cars.

ORENSTEIN-ARTHUR KOPPEL

Coal Charging Cars for the conveying of coal to boiler rooms are made of steel and are very durable. They are light in weight and easy and convenient to operate, being designed with special reference to boiler room service. The height of the cars is such as to make shoveling very convenient for the stoker. They may be supplied either with two side doors or end doors, as desired, and with or without swiveling base.

The rails of the track used in our boiler room systems are cast integrally with solid sectional plates, which provide a level surface to walk upon while car is being propelled.

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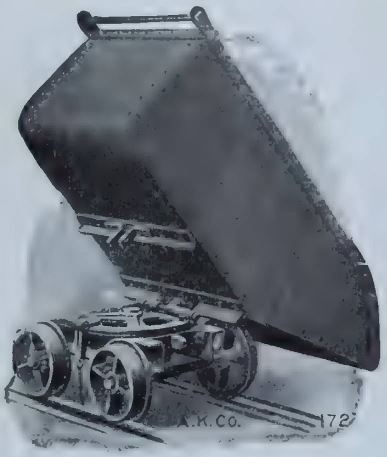

A VERY satisfactory type of car for use in hauling ashes, dirt, etc., is the Scoop Car, which can be dumped either between the rails or to either side. Standard capacities are 12, 18 or 27 cubic feet for gauges of 18 or 24 inches.

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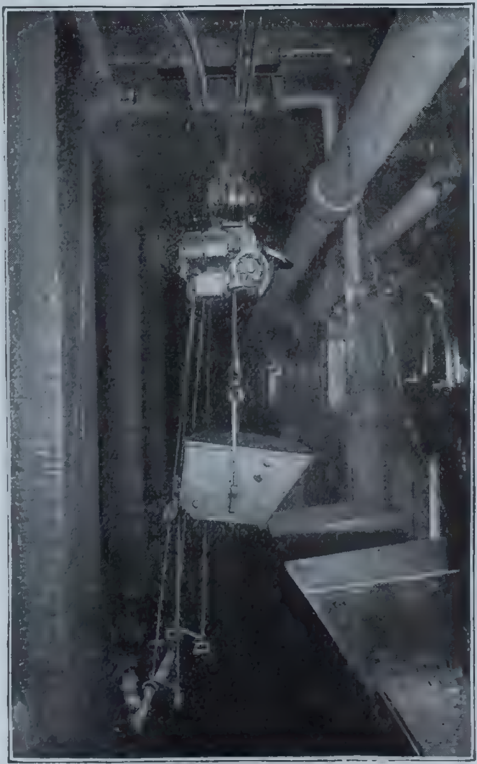

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Upwards of 500,000 now in use. Sizes up to 3 in. in stock.

Send for price list and leaflet No. 5

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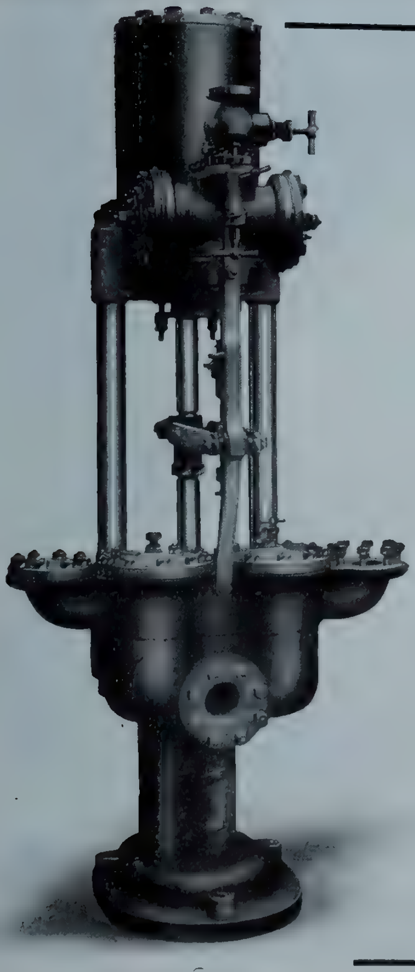

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Over 50,000 now in use.

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Insures Safety, because it is unaffected by sudden changes of temperature. Increases Efficiency, because it lasts and stays clear.

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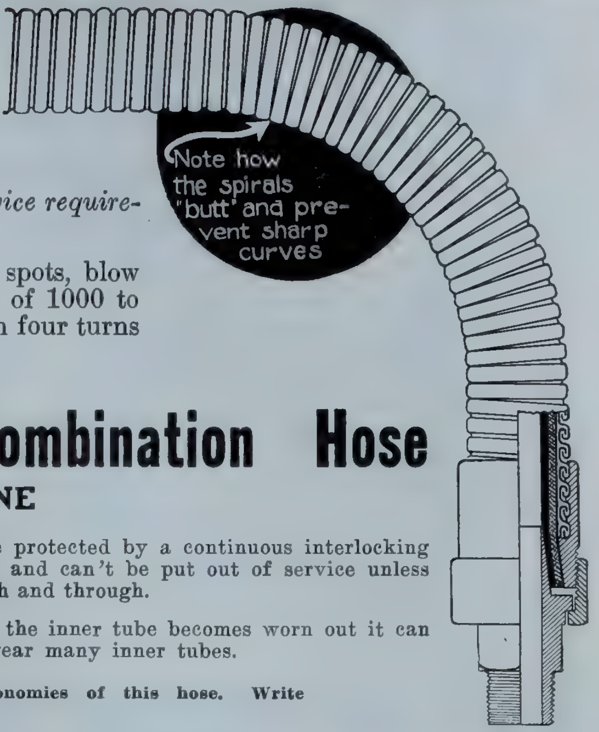

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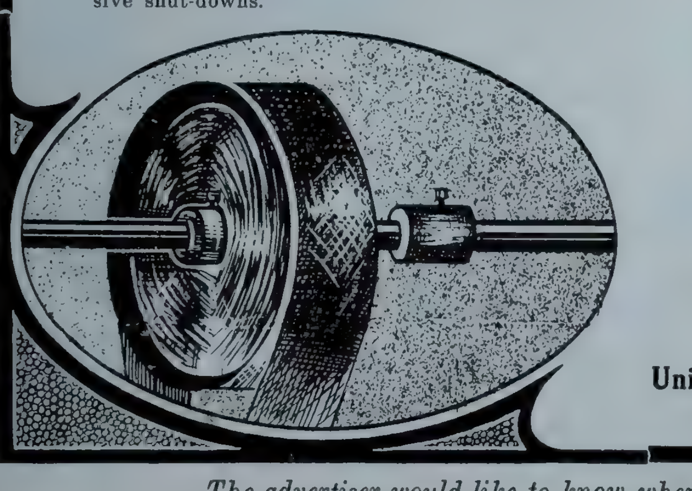
Spartan Belting, by its thousands of users, is conceded to be without an equal for successfully meeting the most exacting requirements.

Why not pick out one of those exacting or troublesome drives in your plant and let us prove to you the efficiency of the **Spartan Brand?** Anyhow let us send further particulars, together with copy of our Spartan Book. **Write to-day.**



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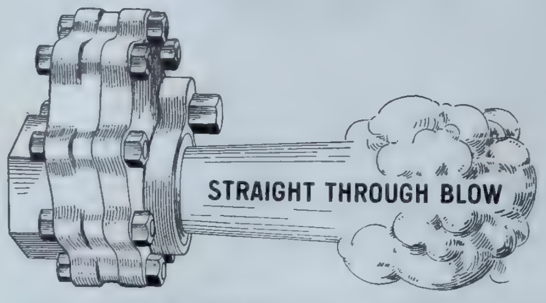

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Does your Boiler leak, Mr. Engineer?

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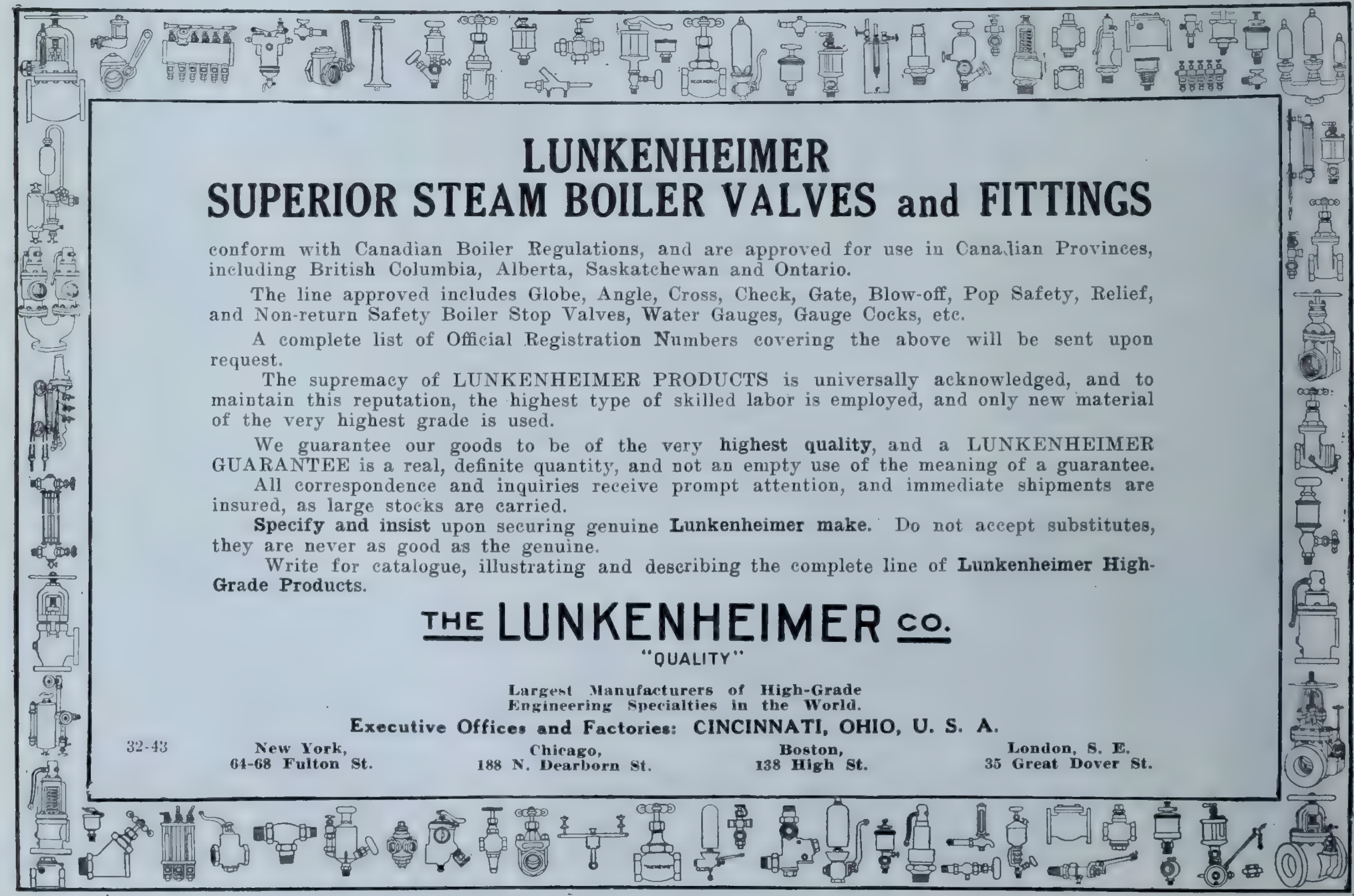

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conform with Canadian Boiler Regulations, and are approved for use in Canadian Provinces, including British Columbia, Alberta, Saskatchewan and Ontario.

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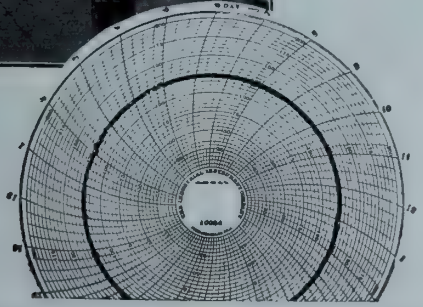

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What the Jones Stoker is doing in this plant at London, Ont., and what it is doing in hundreds of other plants, it will do in yours.

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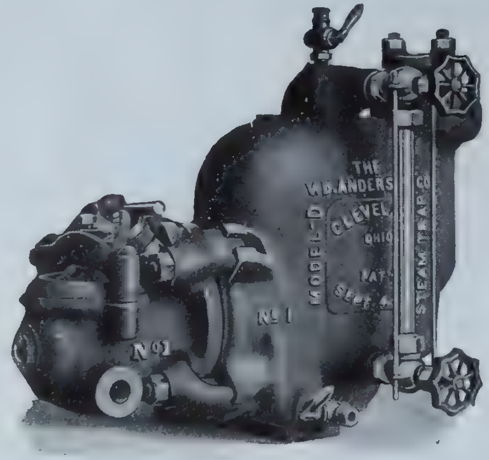

On that 120 lb. main—to protect the engine; on those 60 lb. coils in the vacuum pass; on those big exhaust heaters under the drying ovens. Anywhere, everywhere where there's condensation to handle put an

Anderson
Model "D" Steam Trap

And its unique construction allows you to use the **same trap** in any of those places, merely changing valve and seat to adopt it for varying pressures.

Doesn't this spell "trap economy?" Doesn't it appeal to you who have so many condensation problems to solve?

Rugged in construction, built interchangeably, making no mistakes, the Anderson will take care of your steam-mains with ever-watchful regularity.

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The National is easy to care for—by means of the quick-opening blow-off valve a reverse current may be sent through the filter bed, thoroughly washing it.

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The National Pipe Bending Co.

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46-5

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Stands 465 lbs.

The Test

"Resisto" and other Gauge Glasses were tested against hot pressure when suddenly brought into contact with cold water with the following results:

French Tubes broke at 90 lbs.
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Compound Tubes broke at 225 lbs.
Durax Tubes broke at 405 lbs.
RESISTO Tubes broke at 465 lbs.

THE "Resisto" Gauge Glass is the result of extensive study and experimenting for a **better** Gauge Glass.

Produced by the makers of the "Durax" Glass, the new "Resisto" has supplanted this famous glass. For the "Resisto" is even superior to the "Durax" in every requisite of an ideal Gauge Glass.

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Every genuine "Resisto" Glass has a red line through its center.

THE SCHAEFFER & BUDENBERG MFG. CO.
RESISTO
HIGH PRESSURE GAUGE GLASS

And every genuine "Resisto" Glass bears the diamond trade mark.

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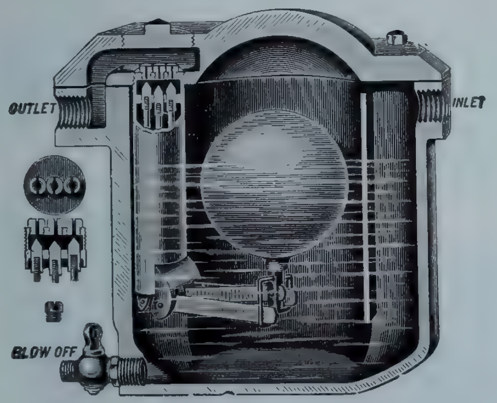

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"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

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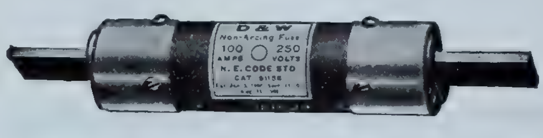
If a fuse fails to "blow" when the overload arrives an expensive motor may burn out.

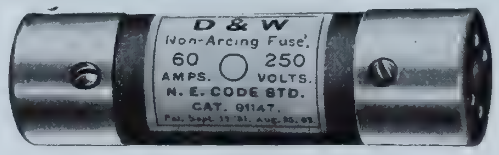
To avoid this danger it is important that you use



D & W Fuses

D & W Fuses have given absolute protection where other fuses have failed.

With a view to safeguarding valuable machinery and preventing possible loss of life give D & W Fuses a trial—we will furnish a sample.



This matter is too important to be delayed. Write to-day to our nearest house for full information.

THE Northern-Electric AND MANUFACTURING CO. LIMITED

Montreal **Winnipeg** **Edmonton**
Halifax **Regina** **Vancouver**
Toronto **Calgary** **Victoria**

Its easy to get an OSTER

OSTER BULL DOG DIE STOCK Made in 7 Different Ranges of Size

In 28 cities of Canada there are OSTER supply houses, giving prompt service to every province.

EVERY TYPE of hand, belt, or motor-driven tool is included in the twenty-year-famous line of

OSTER BULLDOG Pipe Threading Tools

Whether you need a hand tool, a tripod tool or a power machine you will find an OSTER tool exactly fitted to your needs, both in easy operation and proper range of sizes.

THE BULL DOG TALE

Write to-day for catalog of Oster Pipe-Threading Tools and the name of your nearest dealer. The illustrations and detailed information in the catalog will interest you.

The Oster Mfg. Co.
2099 East 61st Street,
Cleveland, O., U.S.A.

Kindly send me catalog **And Name of Nearest Oster Canadian Distributor.**

Name ....

Address ....

Business ....

City ....

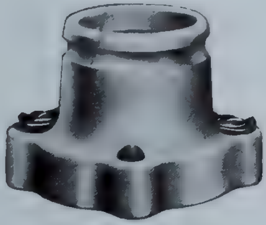
Province 2099

Duncan Receptacles

Guaranteed by this

TRADE DUNCAN MARK

No. 9171 (¾ Actual size)



No. 4013 (¾ Actual Size)

Edison Cleat Receptacles

These receptacles meet every requirement of the underwriters for temporary work. Stalwart in construction, they stand a lot of hard usage.

Sign Receptacles

There are no better receptacles than these. No. 29 is a self-holding receptacle which may be used in a round hole without notches or side holes—a great convenience. No. 1700 is our Pony Sign Receptacle.

No. 29 (½ Actual size)

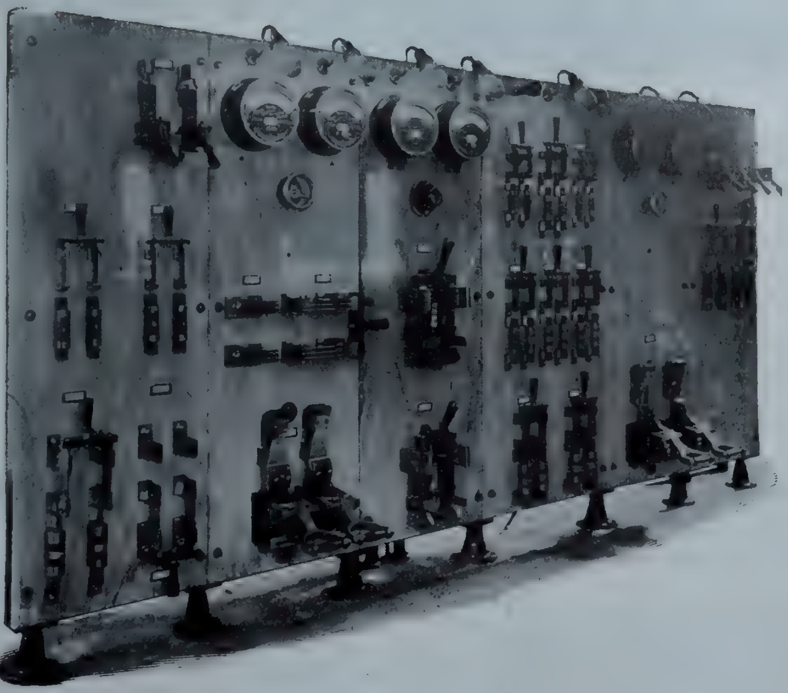
No. 1700 (¾ Actual Size)

Order through your Jobber.

The Duncan Electrical Co., Limited
MONTREAL

MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P. Q., District of Montreal

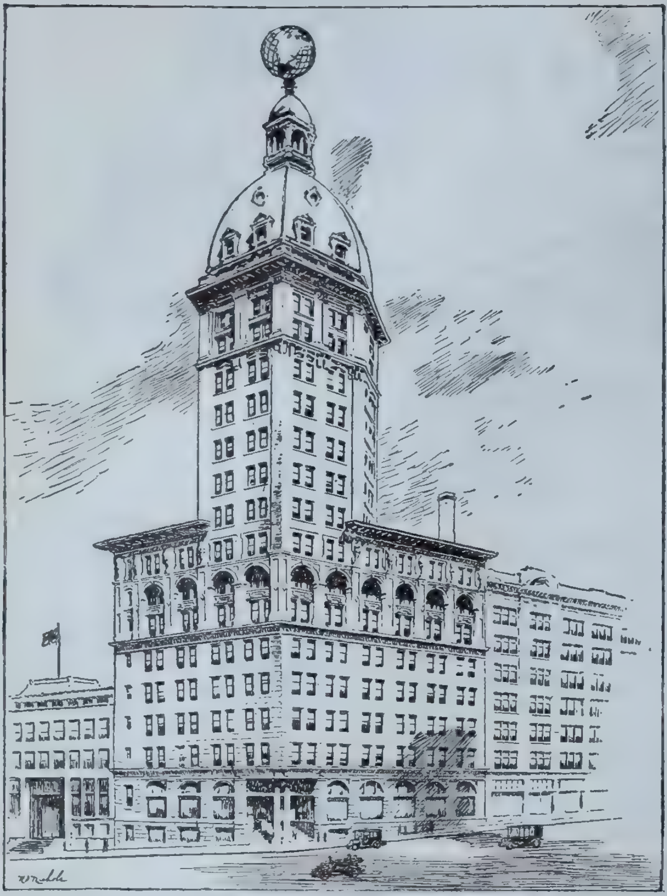


Switch

Board

Specialists

The advertiser would like to know where you saw his advertisement—tell him.



Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Toronto MONTREAL Winnipeg

Seventh of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the

WORLD BUILDING, VANCOUVER

This building was wired with "Adanac" Rubber Insulated Wire.

Architect, W. T. Whiteway, Vancouver.
Engineer, W. E. Hughes, Vancouver.
Electrical Contractor, J. G. Sutton, San Francisco, Cal.

Address enquiries to nearest office

MONTREAL TORONTO WINNIPEG

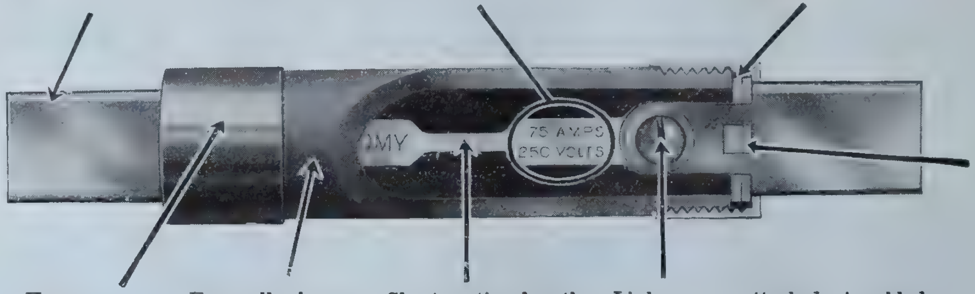
Enquiries from Alberta and British Columbia may be addressed to Northern Electric & Manufacturing Co., Limited, Calgary and Vancouver.

"ADANAC," "IMPERIAL HIGRADE" and "30% PARA."

Round edge hard drawn copper.

Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.

This venting feature allows no fire to escape, even on severe short circuits.



Washer assembly centres, locks in position and aligns blades.

Heavy solid brass cap.

Unusually heavy gray horn fiber shell.

Short, active length of element assures uniform performance.

Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

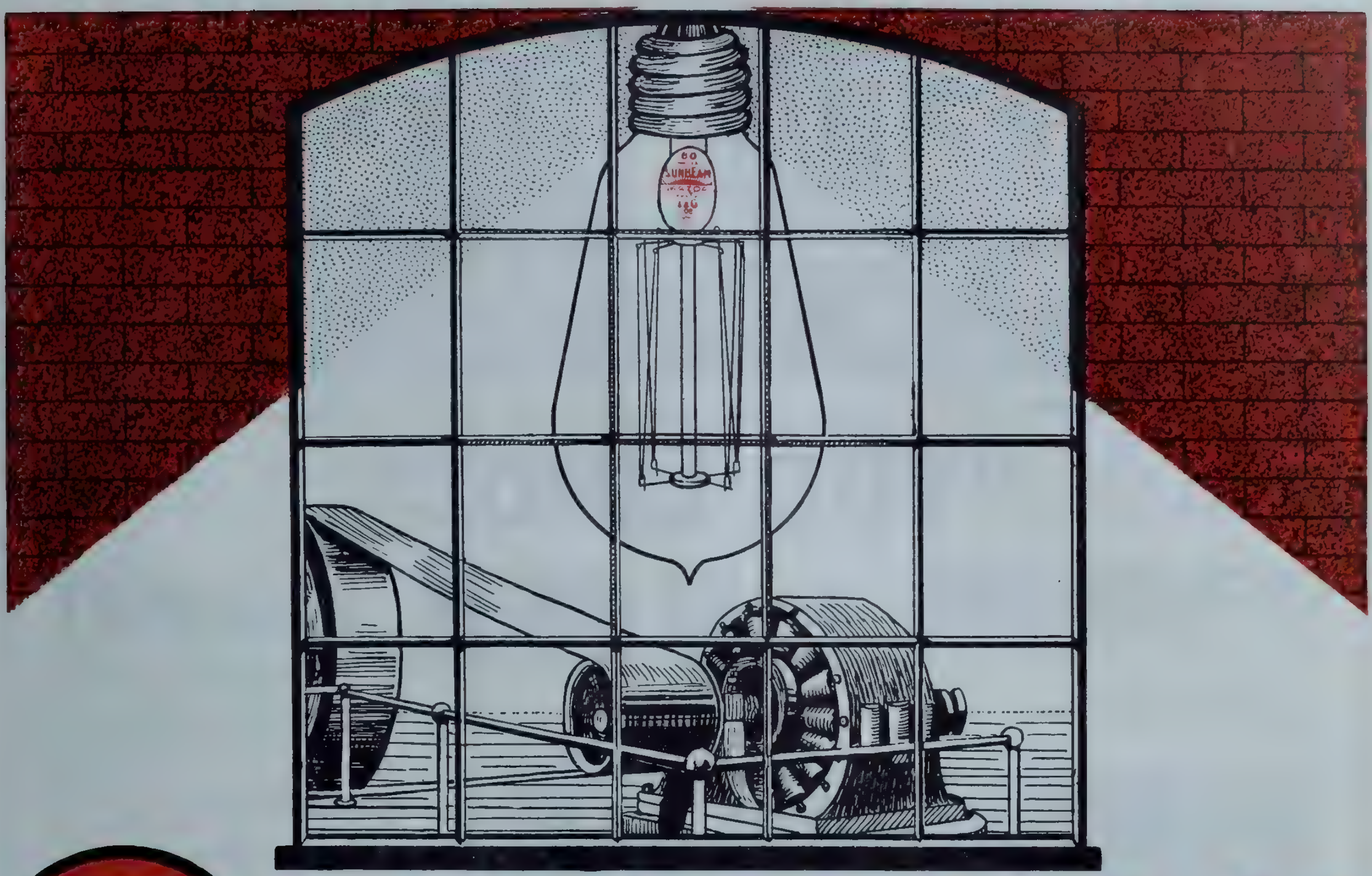
Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.



SUNBEAM MAZDA LAMPS

will enable you to get full returns from electricity generated.

At the same current consumption the lighting efficiency is three times greater than that of the carbon lamp.

The better the light, the better the work of your employees, therefore the better the satisfaction you give your customers.

The Sunbeam Mazda burns in any position—and it is as rugged as any carbon lamp.

We can ship immediately from our large stock.

The Canadian Sunbeam Lamp Co., Ltd.

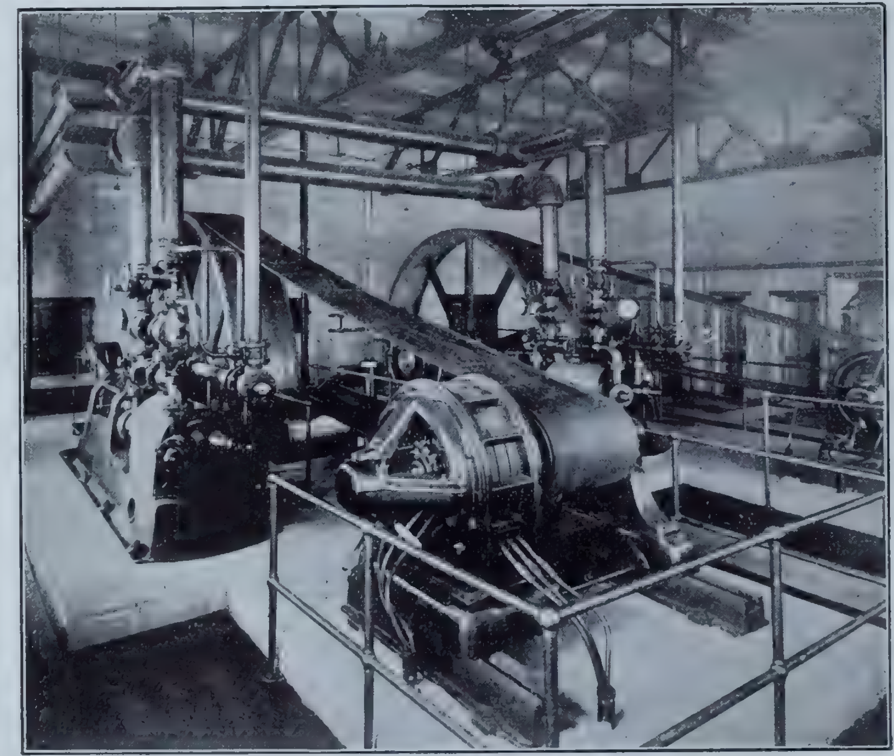
Main Office and Factory, TORONTO. Branch Warehouses, MONTREAL, WINNIPEG, VANCOUVER, CALGARY

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt Drivers, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

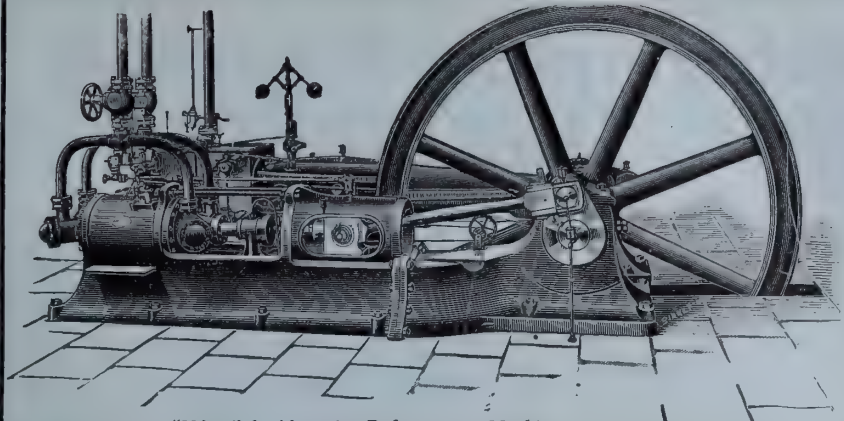
Recent Orders:—

- **McDONAGH & SHEA**, Winnipeg, Man.
- **O. LECLAIR**, Ottawa.
- **MUNICIPAL HOSPITALS**, Winnipeg, Man.
- **CANADIAN NATIONAL EXHIBITION**, Toronto, Ont.
- **C.P.R. VANCOUVER HOTEL**, Vancouver, B.C.
- **C.P.R. CALGARY HOTEL**, Calgary, Alta.
- **SWIFT CANADIAN CO.**, Montreal, Que. (2nd plant).
- **McGILL UNIVERSITY**, Montreal, Que.
- **OTTAWA UNIVERSITY**, Ottawa.
- **MR. J. A. PATRICK**, Westminster Hockey Arena.
- **O. LESAGE**, Montreal, Que.
- **AND MANY OTHERS.**

The Linde Canadian Refrigeration Co.,

Limited
37 ST. PETER STREET, MONTREAL

Branch Offices—Toronto, 28 Front St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, 562 Second Street; Calgary, General Supplies, Limited, 1233 2nd St. East.



“Vilter” double-acting Refrigerating Machine

Established 1867

The VILTER MFG. CO.

242 Becher St. Milwaukee, Wis.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES

ICE AND REFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

Write for Catalogue and full Particulars

Turn Your Refrigerating Problems Over To Our Experts

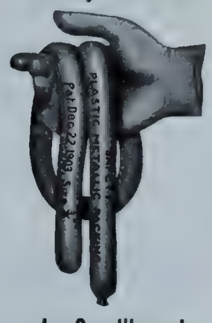
We can help you, whether you require plans and figures on Ice Making Machinery, or complete Refrigerating Equipment for Hotel, Apartment House, Club, Hospital, Dairy, Restaurant or Store.

We have solved such problems in every country in the world—and are quite sure that we can be of service to you. Write us.

The
Linde British Refrigeration
Company, Limited

Has the largest output in the world of Refrigeration Machinery.

Canadian Offices :
Coristine Building, MONTREAL



In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

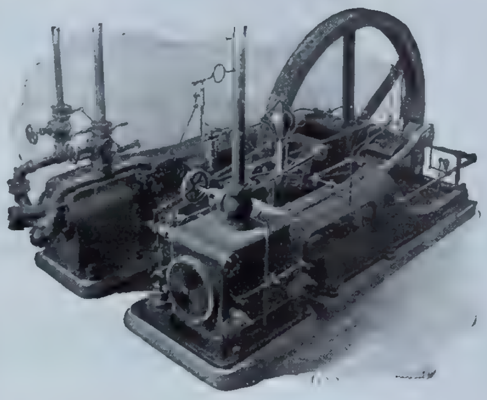
Send for FREE SAMPLE and particulars.

Manufactured only by

STEEL MILL PACKING CO., WINDSOR, ONT.

Any Quantity sent on APPROVAL

When Buying Refrigerating Machinery Better Be SURE Than SORRY



Some Ice Making and Refrigerating Plants are failures, not by reason of any inherent defects in the Machine or Apparatus, but because the type of Plant installed is not suited to meet existing conditions.

A Refrigerating Plant erected several years ago was found to be incapable of performing the duty required of it. Being given an opportunity to confer with the owners, we recommended a Plant of a different type, which was installed, and now the work is being done with ease, and at a considerable saving in water and fuel consumption.

This is not a knock. It's a boost. Every unsuccessful Plant is a detriment to the trade in general. A little care exercised in the beginning may prevent a bad investment—it is better to be Sure than Sorry! Our complete line enables us to make recommendations without prejudice. Why not safeguard your interests by giving us an opportunity to estimate on your requirements? Costs you nothing—may save you time and money.

We are ready and willing to confer with you on this important subject if you will but give us the opportunity.

Write us to-day.

YORK MANUFACTURING COMPANY

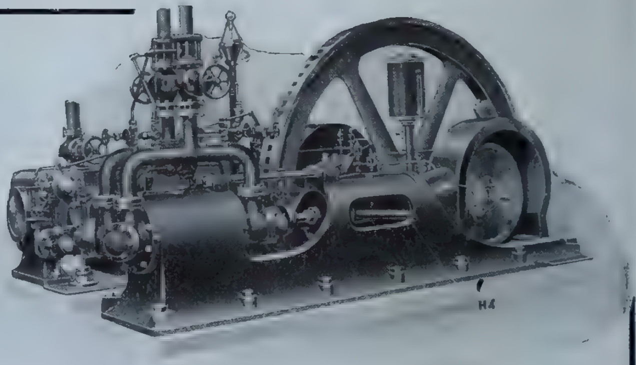
Largest Manufacturers of Ice Making and Refrigerating Machinery in the World

Main Office and Works: YORK, Pa., U.S.A.

Represented in the Dominion by **CANADIAN ICE MACHINE COMPANY**

TORONTO, 163-167 Yonge Street
MONTREAL, 324 Coristine Bldg.
WINNIPEG, 80 Lombard St.

FRICK



Refrigerating and Ice-Making Machinery and Equipment

is acknowledged the world over to have attained the highest degree of efficiency. For thirty-three years FRICK Machines have successfully endured the wear of exhaustive tests and proven all guarantees made.

It will pay YOU to KNOW US.

The FRICK is the only machine of which it can be said "There is no better machine built." The FRICK is durable—efficient and will last a lifetime.

We build all types of Refrigerating Machines—Vertical Single-acting, Horizontal Double-acting and Absorption.

WRITE FOR CATALOGUE TO

FRICK COMPANY, - Waynesboro, Pa., U.S.A.

KEITHS LTD., TORONTO NEW YORK CHICAGO PITTSBURGH CLEVELAND
ST. LOUIS DALLAS ATLANTA BALTIMORE BOSTON
United Iron Works: Oakland and Los Angeles Cal., and Seattle, Wash.

J. V. Jamison, President. **T. B. South**, Vice-President. **J. V. Jamison, Jr.**, Treasurer.

The Correct estimated value of

A Refrigerator Door and Window

—is service.

1st. Efficiency

2nd. Strength and Durability.

Jones Cold Store Door Co.

Hagerstown, Maryland

products combine and recommend to the trained and untrained eye, unexaggerated ability to perform its work and to stand up to its place. The construction object is in defiance to the

Slam Bang Laborers "Disable Me If You Can"

HINGES AND FASTENERS weigh 60 lbs. to the set. The Doors and Windows work as easy as the front Door on your dwelling.

They will not leak.

Refrigerator Doors and Frame and Windows mean shipped complete ready to set in the opening.

We guarantee our "AD" statements.

We believe a big part of our success is due to pleasing our Patrons.

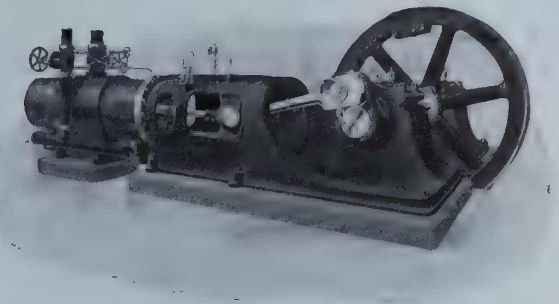
We are the sole manufacturers of the "NOEQUAL" DOOR with round jambs, so popular with the packing trade.

Our Revolving Ice Cream Door is a success for its purposes.

Our Ice Doors and Chutes do all that is required.

Jones Cold Store Door Co.

HAGERSTOWN, MD., U. S. A.



Arctic Electrically Driven

Ice plants are producing pure, crystal ice in cans, at a decreased cost for power and labor, and making a finer quality ice than the distilled water product.

This result is accomplished by installing our

Raw Water Ice Making Equipment

using the Arctic-Pownall System.

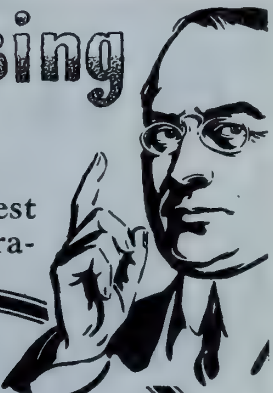
Any cheap motive power, such as water power, oil or gas engine, or electricity may be used.

Full particulars and printed matter will be mailed you — simply write us saying you are interested.

"We do it Right."

THE ARCTIC ICE MACHINE CO.

CANTON, OHIO, U.S.A.



You're Losing Money

If you are not using the best insulation in your refrigeration plant.

You Can Stop That Loss At Once By Using Our

Corkboard Insulation

It is made of pure cork, and is recognized as the best insulation for cold storage and refrigerating purposes.

It is the only cork insulation that is made in Canada.

Write for full particulars.

Robinson Bros. Cork Co.,
LIMITED

HEAD OFFICE—803 LUMSDEN BLDG. TORONTO

FACTORY—
PORT COLBORNE, ONTARIO

Consider These Truths:

The same advantages that make the **Simple, Serviceable "Safety"** the choice of **American** Ice and Refrigerating experts, makes it the selection of **Canadian** Engineers and users wherever absolute safety, efficiency and economy is considered.

Wherever **you** are we can build a Safety Compressor—or a Complete Ice or Refrigerating Plant—to your requirements.

Get our Booklet "Cold Facts" and Catalogue B-4.

The Huetteman & Cramer Co.

Simple—Serviceable—"Safety" Ammonia Compressors.

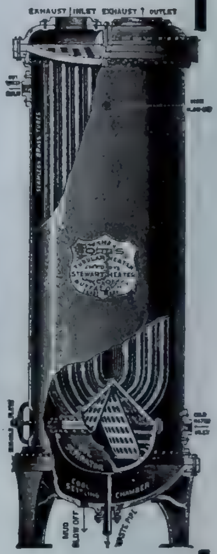
DETROIT - MICH., U.S.A.

Save Fuel and Increase Profit

A few engineers find this a difficult problem. They are not acquainted with

The "OTIS"

TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER



The exhaust steam when harnessed and passed through this Heater will heat the Feed Water to a boiling point before it enters the boiler. This effects an enormous yearly saving in fuel.

Write for descriptive catalog and prices.

The STEWART HEATER CO.

189 Norfolk Ave., Buffalo, N.Y., U.S.A.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and many of our machines installed over twenty years ago are to-day maintaining their high initial performance.

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

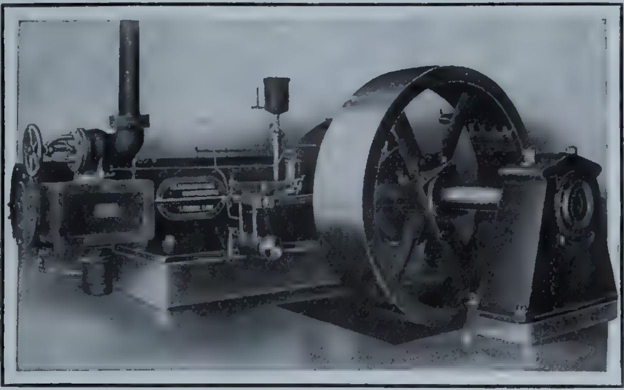
The name De La Vergne stands for highest quality, maximum capacity, absolute reliability and permanent economy.

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

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WATER TURBINES
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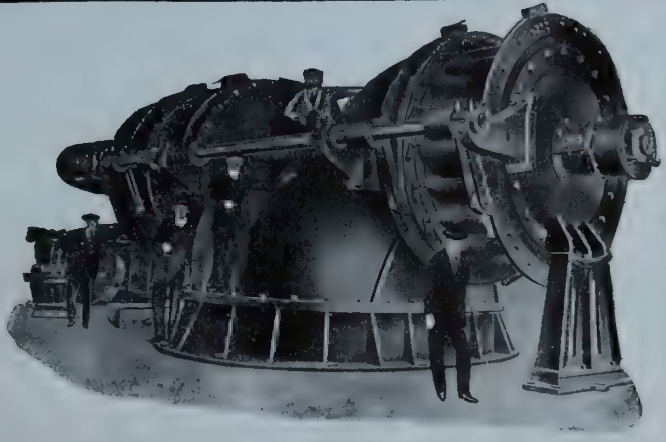
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM

BOVING & CO. OF CANADA, Limited

164 BAY STREET, TORONTO.

Branch Office for British Columbia, 448 Seymour St., Vancouver

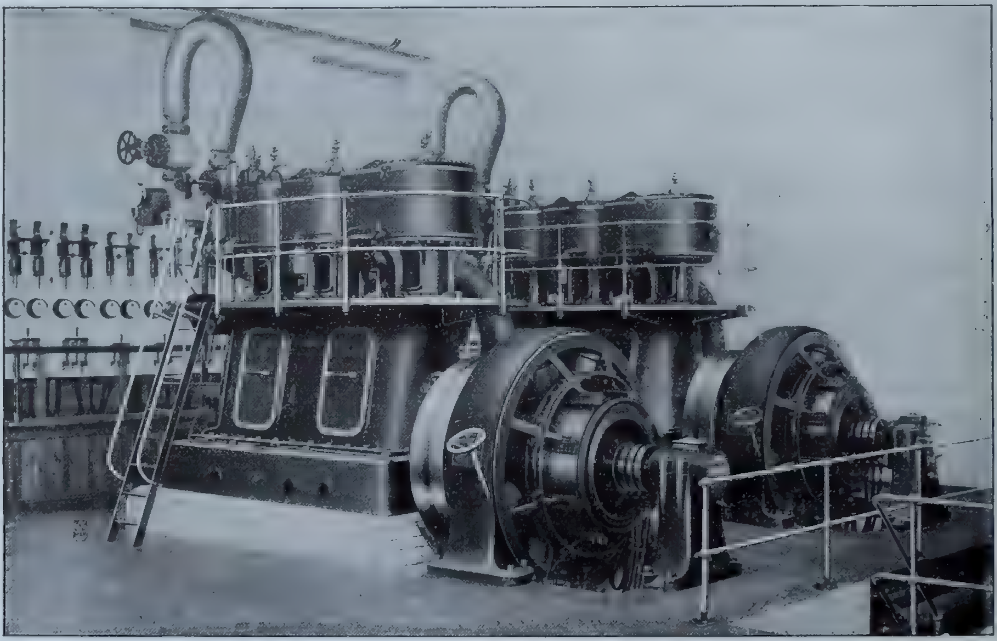
THE BELLISS ENGINE

THE HIGH-SPEED, DOUBLE-ACTING, FORCED LUBRICATION ENGINE WAS ORIGINATED BY US IN 1890, AND SINCE THAT DATE WE HAVE ACTUALLY MANUFACTURED

5,000 ENGINES

REPRESENTING

1,000,000 HORSE POWER



600 H.P., 350 R. P. M., Belliss Triple Expansion Engine.

Two of the Above Type of Engines Recently Ordered for the Toronto Waterworks.

We have installed upwards of 150 Belliss Engines in Canada.

Manufacturers :

Belliss & Morcom, Limited

BIRMINGHAM **ENGLAND**

Sole Agents :

LAURIE & LAMB

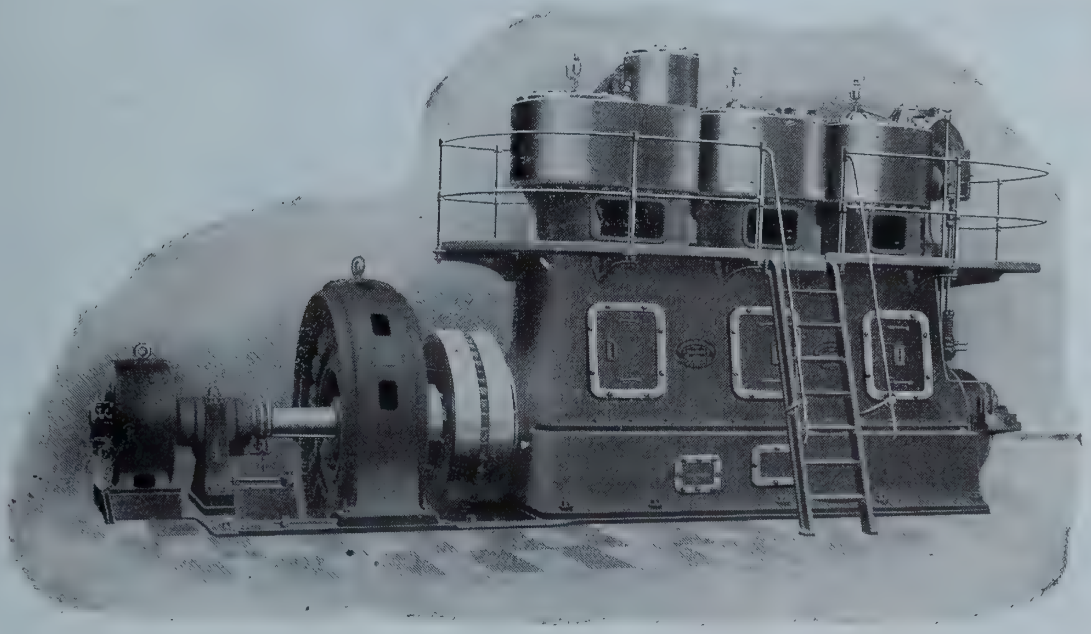
211-212 Board of Trade Building **MONTREAL**

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

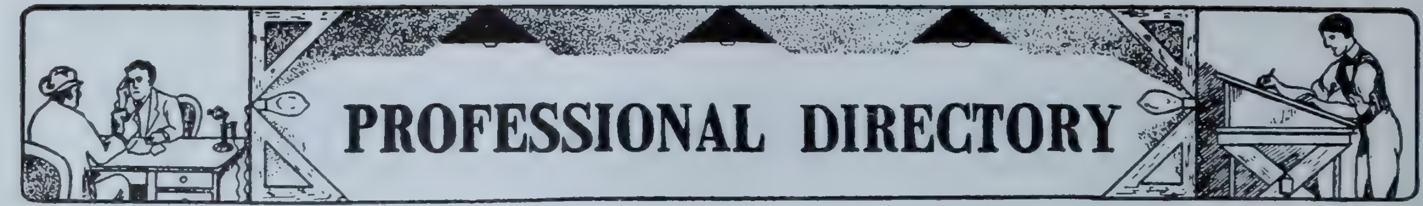
Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada :

THE JOHN McDOUGALL
CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.



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CONSULTING ENGINEERS.
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D. R. O'Neail, Reg. Pat. Attorney, U. S. A.

PATENTS
(of Invention)
Van-Hallen & O'Neail
Offices, Room B, 103 Farmer Building., Winnipeg, Man.

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Mechanical, steam, electrical and hydraulic engineering. Specialist on Automobile and Gasoline engines. Inspection, Appraisal.
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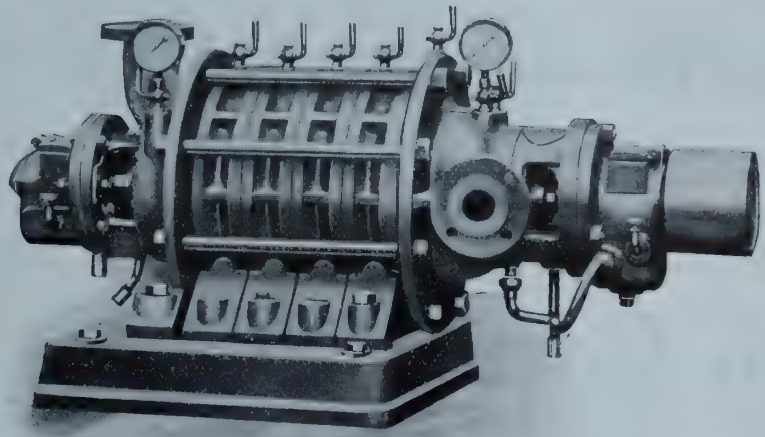
LIMITED

QUEEN'S ENGINEERING WORKS, BEDFORD, England

ENGINEERS AND BUILDERS OF

Steam, Hydraulic and D.C. Electric Machinery



“CONQUEROR”
PUMPING MACHINERY

Above illustration shows a five-stage pump, sixty Imperial gallons per minute, 450 ft. head, 2,500 r. p. m.
for

BRITISH COLUMBIA

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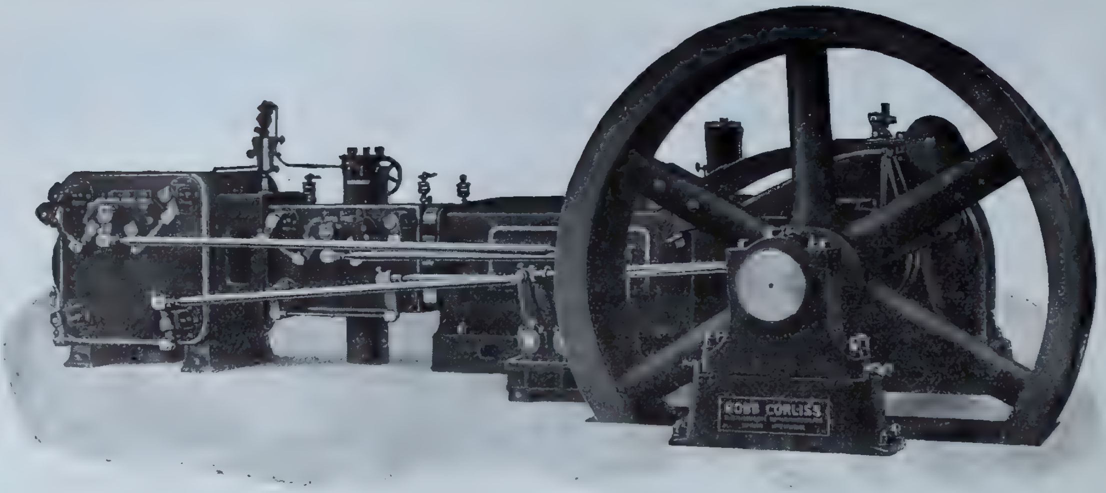
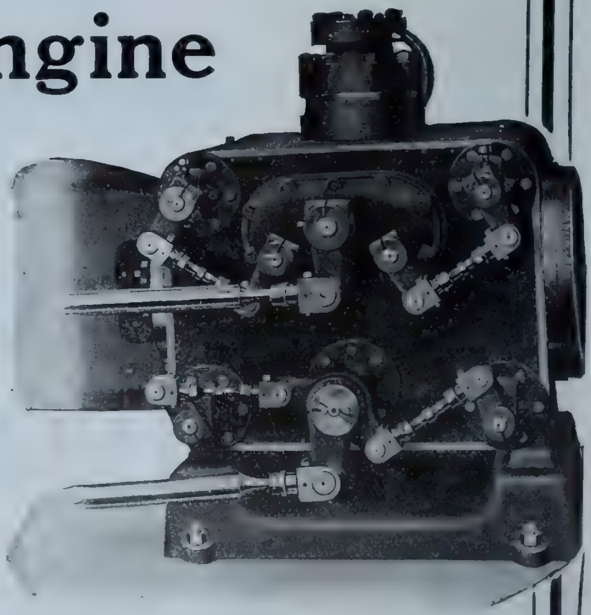


Corliss Economy and High Speed

Here's an engine which will save you fuel, for it's a Corliss. It runs at high speed—225 revolutions per minute—and the valve gear has only about one-half as many parts as the ordinary Corliss gear.

With a

Robb Corliss Engine



you don't have to sacrifice fuel saving for high speed. You don't have to get a slide valve engine for simplicity, or a vertical engine to save floor space. This engine combines Corliss saving with high speed and simplicity.

The valve gear has no springs, no latches, no cams, no disengaging parts. Multiported Corliss Valves permit small clearances, and use the steam almost perfectly.

Both single cylinder and compound.

Ask for Robb Bulletin No. 202.

International Engineering Works, Limited

Manufacturers of

ROBB ENGINES AND BOILERS

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Transportation Building, Montreal......R. W. Robb, Manager
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321 Edmonton Street, Winnipeg..........J. F. Tracey, Manager
Grodwards Company, Cobalt, Ont.

AMHERST, N.S., CANADA
SO. FRAMINGHAM, MASS.

39-60

Why The Advertiser Succeeds.

¶ Why is it that during the last few months, when money was admittedly tight, the manufacturers who advertised the most felt the pinch the least?

¶ And how is it that now, when the circulation of money is less restricted, the manufacturers who felt the pinch the most will be the last to experience relaxation and relief?

¶ The same wisdom and foresight which prompts a manufacturer to advertise will naturally guide him in forming his whole selling and general business policy, and, like a good general, he is prepared for every contingency and emergency.

¶ The fact that the successful business men is an advertiser is usually incidental. He is an advertiser because he is wise and possessed of good sound business sense and an analytical mind. At some time or other he came to the conclusion that advertising could be made one of the mightiest factors of his business organization, and having arrived at this conclusion, he just naturally went to it and advertised.

¶ He had faith in his product, and his own faith manifested in a public way, inspired confidence in the minds of his prospective customers. His name and his manufactured product became synonymous with good service and satisfying quality. The public became acquainted with the merits of his line and familiar with its outstanding features.

¶ Consequently, when conditions were normal, he secured a liberal share of business and received first consideration when purchases were made.

¶ When money tightened and business was curtailed, he continued to get the lion's share of what was going. When purchases were carefully considered the advertised line received first attention and usually secured the order.

¶ And now that the financial tide is coming back, the advertiser is getting the biggest slice of the business melon, simply because during those cloudy days of curtailment, his advertising message had been studied and absorbed at a time when the public mind was most receptive.

¶ It pays to advertise if your line is good, and it pays to buy advertised lines, because they are invariably satisfactory. The general public have long been educated to believe that advertised goods are best. Can't you see that you are laboring, not only under a handicap, but under a cloud, if your product is not advertised? Publicity dispels the cloud of suspicion and removes the handicap.

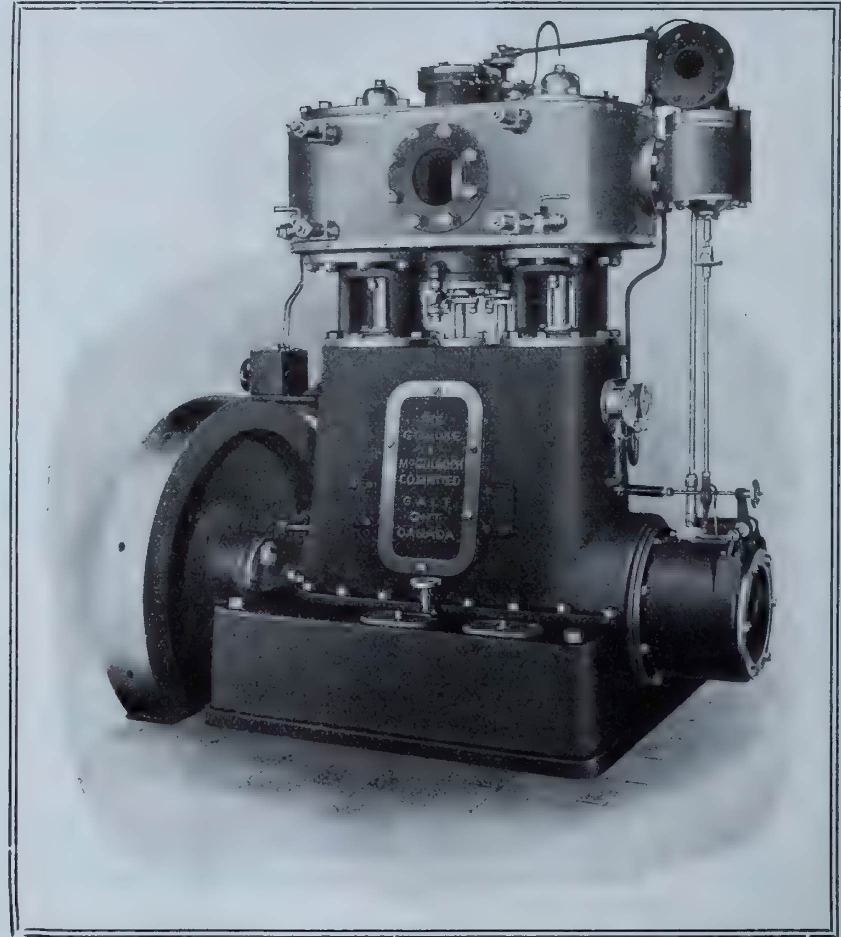
¶ You'd better hop on to the band wagon right away. Hopping on now, when the prospects for big business are so bright, will be not only timely, but extremely profitable.

G. & McC. VERTICAL QUICK REVOLUTION STEAM ENGINES

Will give you as they are giving others wherever installed

A MAXIMUM OF SERVICE

At a Minimum Cost of Upkeep



These Engines have a Perfect System of forced Lubrication.

They require little or no attention while running.

Built in all types and sizes.

They run with Practically no Noise or Vibration.

All working parts are very easy of Access.

Built to suit your Particular Requirements.

Two Cylinder Compound, Vertical Forced Lubrication, Quick Revolution Steam Engine, with Combined Throttle and Expansion Governor.

All the materials used in the Manufacture of Vertical, Quick Revolution Engines must be the best obtainable. In the construction of our Engines particular attention has been paid to this feature; the materials supplied being in accordance with **British Admiralty Specifications.** All Engines are tested under steam before leaving our works.

We shall be pleased to furnish Specifications and further information.

THE GOLDIE & McCULLOCH CO., LIMITED

Head Office and Works: GALT, ONTARIO, CANADA

Branches or Agencies:

TORONTO	MONTREAL, QUE.	WINNIPEG, MAN.	VANCOUVER, B.C.	ST. JOHN, N.B.
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The Power Feature in Prominent Canadian Mfg. Plants

Staff Article

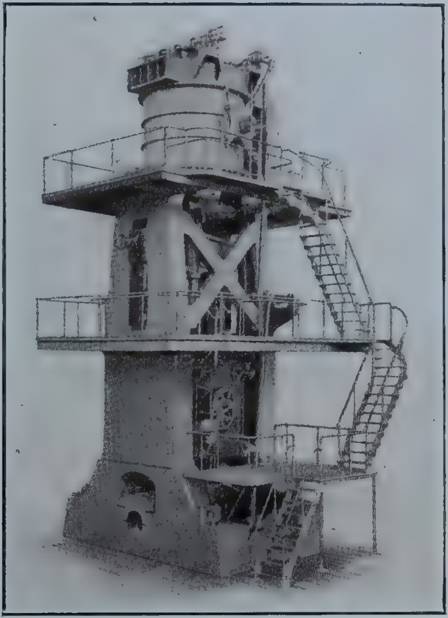
The contents of this illustrated descriptive article are indicative of a variety and purpose of equipment for power generation and transmission, and serve to show that plant location and nature of product contribute largely to the detail and unit combination selected and installed. Again, the increasing recognition of the necessity of heating and ventilating our factories brings into prominence a line of equipment closely allied with that of power generation and transmission.

THE CANADIAN FURNACE CO.

THE Canadian Furnace Co. recently started operations at their new plant, Port Colborne, Ont., for the manufacture of pig iron. The furnace was successfully blown-in on September 27, and on the following day a heat was drawn. The site of the plant is called Victoria. It is situated at the junction of the Welland Canal and Lake Erie, with a frontage of 2,200 ft. to the canal, 660 ft. of which is already docked; the remainder to be converted into dockage as fast as improvements can be carried out. Where the furnace now stands was originally under water to a depth of 5 ft. The bottom, however, is rock, upon which the foundations were laid by means of cofferdams.

Stoves.

For heating the furnace blast, three stoves have been installed by the Variety Iron & Steel Co. They are of the upblast vertical type, made of steel plate and lined with fire brick, 250,000 bricks being required for each stove. The stoves are located near the furnace, are 85 ft. high and 20 ft. diameter inside, and have a connecting platform on the top. They are arranged so as to work in series. While two are being heated by the waste furnace gases, the third, having previously been heated, is warming the air which is passing through from the blowing engines to the tuyeres. The furnace gases pass through the 6 ft. diameter downcomer which connects the furnace top with the stoves and is equipped at the top with two bleeders which are set to go off automatically when the pressure rises above a certain point. In the downcomer is installed a gravity type dust catcher which is set above the tracks, allowing the cars to go under and carry away the dust when necessary.

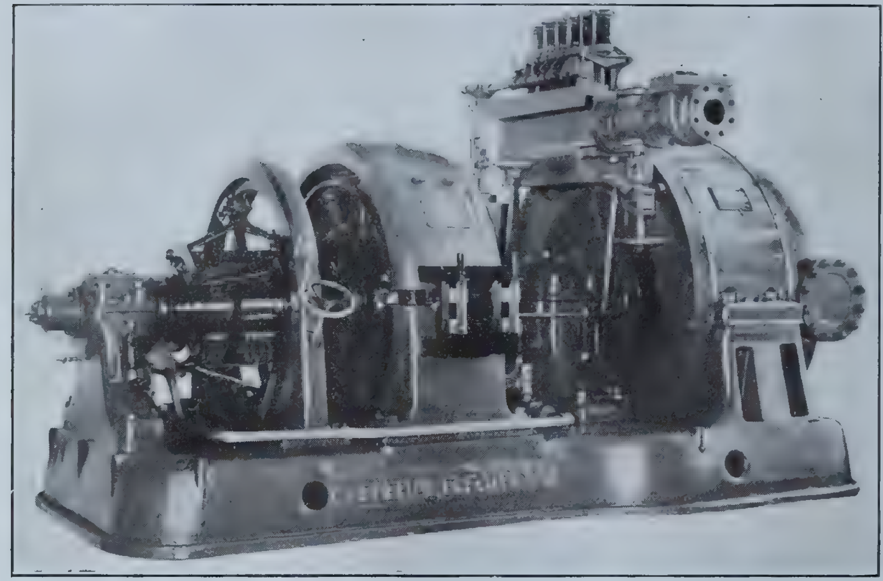

SINGLE UNIT, VERTICAL LONG CROSS-HEAD BLOWING ENGINE.

Boilers.

The boiler house is 120 ft. long by 35 ft. wide and is of steel and brick construction, the steel work being supplied by the Canada Foundry Co. The boilers are of the vertical water tube type, manufactured and installed by the Wickes Boiler Co., Saginaw, Michigan. The 8 units chosen are of 300 horsepower each, two in a battery; making a total of 2,400 horse-power, thus a very flexible and accessible plant. The boiler working pressure is 150 lbs. per sq. inch.

GENERAL VIEW OF PLANT FROM YARD ENTRANCE.

The Dutch oven type of furnace is installed in connection with the boilers, the arrangement being recognized as a most economical and satisfactory method of burning bituminous coal. Besides the hand-fired grates for burning coal, each boiler has two flues through which blast furnace gas may be introduced into the furnace, thus affording a further economy by using combustible gases that are so often allowed to escape. The Dutch oven is especially helpful for the combustion of this gas as it permits of a very thorough mixing of air and gas, and maintains a temperature close to ignition point of gases, until the latter reach the heating furnace.



300 K.W. CURTIS TURBO-GENERATOR.

The travel of the gases through the boiler proper is unusually long and closely confined to the heating surface. The gases leave the boilers through short steel necks to the underground smoke flue leading to the stack. The underground smoke flue has the advantage of not interfering with the cleaning of the soot from the heating surface. Soot cleaning doors are located at convenient points in the setting. These doors are reached by the aid of platforms to facilitate blowing the soot off the heating surface. There are two manholes in the upper and lower drums to allow for close inspection of the interior. All the steam piping was furnished by the Best Mfg. Co., Pittsburgh, the main steam line being 14 in. diameter with 6 in. diameter leads to the boilers. Between the boiler house and stoves is a brick stack, 150 ft. high and 10 ft. diameter inside, built by the Heine Chimney Co., Chicago.

Power House.

The power house is of substantial brick construction and is 80 ft. long by 60 ft. wide, inclusive of the pump pit. It contains the blowing engines, the electric power generating sets, pumps, etc. The blowing engines, supplied by the Allis-Chalmers Co., Milwaukee, Wis., are of the compound long crosshead vertical type, with the air cylinders located above the steam cylinders. The H.P. steam cylinder is 48 in. diameter and the L.P. 84 ins. diameter, while the air cylinders are 84 ins. diameter on both sides. The stroke is 66 ins. Corliss valves are fitted to the steam cylinders. The guaranteed capacity of the blowing engines is 380 cu. ft. of air per revolution when running at 55 r.p.m. against a pressure of 30 lbs. per sq. in. The normal speed, however, is about 40 r.p.m., and pressure 15 pounds. The engines are of the same type and make as others installed at the Buffalo plant where they have given very satisfactory service.

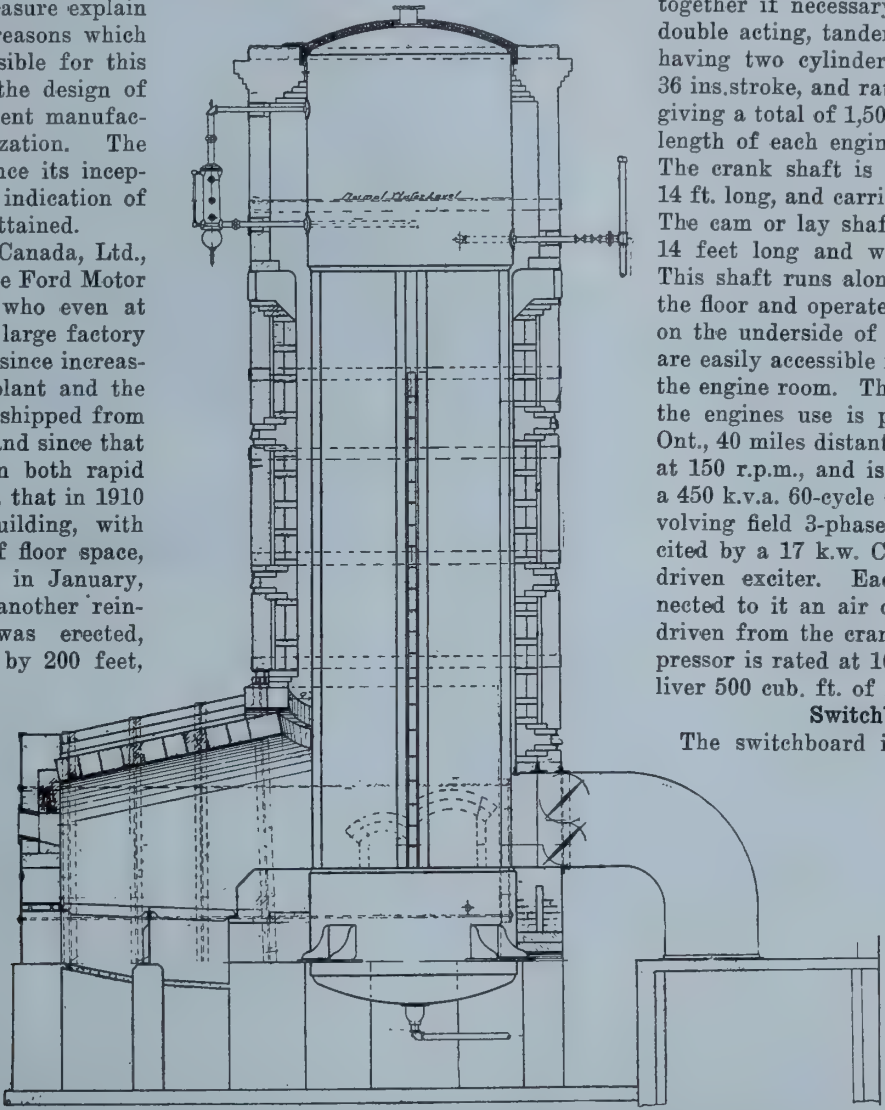
An interesting feature regarding these blowers is that they can be operated independently or as a compound unit by a suitable arrangement of the steam and exhaust piping. The H. P. side can be operated as a simple blower taking steam at boiler pressure. Likewise, the L.P. side can be run independently although in this case a reducing valve would have to be used to reduce the boiler pressure to what would be the receiver pressure when the engines were running compound.

The company generate their own power, and for this purpose have installed two Curtis impulse type steam turbines which are direct-connected to 300 K.W. D.C. generators 125-250 volt, three wire, and run at 1800 r.p.m. These sets were supplied by the Canadian General Electric Co. The six panel switchboard is equipped with the usual instruments and was supplied by the Canadian General Electric Co. A 10-ton overhead hand travelling crane, built by the Euclid Crane Co., Cleveland, Ohio, serves the power house.

On one side of the power house is the pump pit, containing the pumps, condensers, etc. The condenser was supplied by the Deane Steam Pump Co., Holyoke, Mass., who also supplied a duplex type condenser pump, 20-26--24 in. A Cochrane heater provides feed water at 130 degrees Fah. The heater was supplied by the Canadian Allis-Chalmers Co., and in connection with it are two Worthington 12-17-12 in. boiler feed pumps, duplex type. The stand pipe is fed with water from the lake and for

BOILER BATTERY PREVIOUS TO ERECTION OF BOILER HOUSE.

this purpose two Worthington 16-18-18 in. duplex steam pumps have been installed. The stand pipe located between the power house and the furnace is of steel construction, 18 ft. diameter and 65 ft. high, and was supplied and erected by the Canadian Allis-Chalmers Co.



SECTION THROUGH BOILER SETTING AS ARRANGED FOR UTILIZATION OF WASTE HEAT. CANADIAN FURNACE CO. PLANT.

◆

FORD MOTOR CO. OF CANADA, LTD.

THE history of the Ford Car has been one of phenomenal success, and a visit to the Canadian home of the "Ford" will in a great measure explain the reason for this. The reasons which are perhaps chiefly responsible for this success are standardizing the design of the car together with efficient manufacturing methods and organization. The growth of the company since its inception, nine years ago, is an indication of the success that has been attained.

The Ford Motor Co. of Canada, Ltd., was organized in 1904 by the Ford Motor Co. of Detroit, Michigan, who even at that time were operating a large factory in the latter city, and have since increased enormously both the plant and the output. The first car was shipped from Walkerville, Ont., in 1905, and since that date the progress has been both rapid and continuous, so much so, that in 1910 a three-storey concrete building, with about 19,000 square feet of floor space, was built and completed in January, 1911. In the same year, another reinforced concrete building was erected, having four floors 75 feet by 200 feet, containing 60,000 square feet of floor area, and built over the river bank. A new office building was also built this year.

In 1912 the capital stock of the Company was increased from $150,000 to $1,000,000 and the name changed to the Ford Motor Co., of Canada, Ltd. About this time, the district in the vicinity of the factory was incorporated as a town and given the name of Ford. This district adjoins the town of Walkerville, but the town of Ford has a separate municipal organization. In 1902 another concrete factory was built 75 feet wide by 505 ft. long and was a continuation of the 1911 building. This extension completed the main building which is now 705 feet long by 75 feet wide, and is built parallel to the river. The Company have a site covering 60 acres situated on the Detroit River and have a siding connection with the Grand Trunk and Essex Terminal Railway. On that part of the property across the main road and directly opposite the factory, a modern power house and boiler room have been built. The location of the plant is good as cheap power in the form of natural gas is used and shipping facilities to the various markets are of the best.

Power Plant.

Crossing the road we come to the power house which is a brick building of handsome appearance and about 60 ft. square. The roof trusses are steel with a concrete roof. The windows with steel sash extend almost the full height of the building and on three sides. The walls inside are lined with white glazed brick, with the result that this is perhaps the brightest and cleanest power house t obe seen anywhere. The equipment generally is of the most modern type.

The power installation consists of two horizontal gas engines made by the Hooven, Owens & Rentschler Co., Hamilton, Ohio, to the designs of Edward Grey, an engineer on the staff of the Ford Co. at Detroit. Both engines are identical in design except that they are right and left-hand. They are operated as separate units, but can be operated together if necessary. They are of the double acting, tandem 4-cycle type, each having two cylinders 24 ins., diam. by 36 ins.stroke, and rated at 750 h.p. each; giving a total of 1,500 h.p. available. The length of each engine overall is 40 feet. The crank shaft is 18 ins. diameter by 14 ft. long, and carries a 20 ton flywheel. The cam or lay shaft is 4¾ ins., diam., 14 feet long and weighs 1,900 pounds. This shaft runs alongside the engine on the floor and operates the valves located on the underside of the cylinders which are easily accessible from the floor under the engine room. The natural gas which the engines use is piped from Tilbury, Ont., 40 miles distant. Each engine runs at 150 r.p.m., and is direct-connected to a 450 k.v.a. 60-cycle Crocker-Wheeler revolving field 3-phase generator, and excited by a 17 k.w. Crocker-Wheeler belt driven exciter. Each engine has cennected to it an air compressor which is driven from the crank shaft. Each compressor is rated at 100 h.p., and will deliver 500 cub. ft. of free air per minute.

Switchboard.

The switchboard is of the automatic type and was supplied by the Canadian General Electric Co. It has panels made of natural black slate and is mounted on iron pipe framework with a full complement of instruments which have a dull black finish. The switchboard controls are as follows: — 2-480 volt, 500 k.w. 3-phase, 60-cycle engine driven generators; 2-110 volt, 17 k.w. exciters; 1-35 k.w. 110 volts, exciter direct connected to a 50 h.p. motor; 3-180 feeders; 1-100 k.w. 3-phase transformer; 3-35 k.w. single phase, 3 wire lighting feeders.

The apparatus controlling the above is mounted on a bench board to be seen in the illustration. The bench board is fitted with a number of switches and illuminated indicators. A 20-ton hand-operated overhead Niles travelling crane is installed and mercury vapor lamps are used for lighting.

It will be interesting to note that there is operating at the Detroit factory a 5,000 H.P. gas engine made by the same firm as the one described above. This unit is perhaps one of the largest gas engines installed in a factory on this continent.

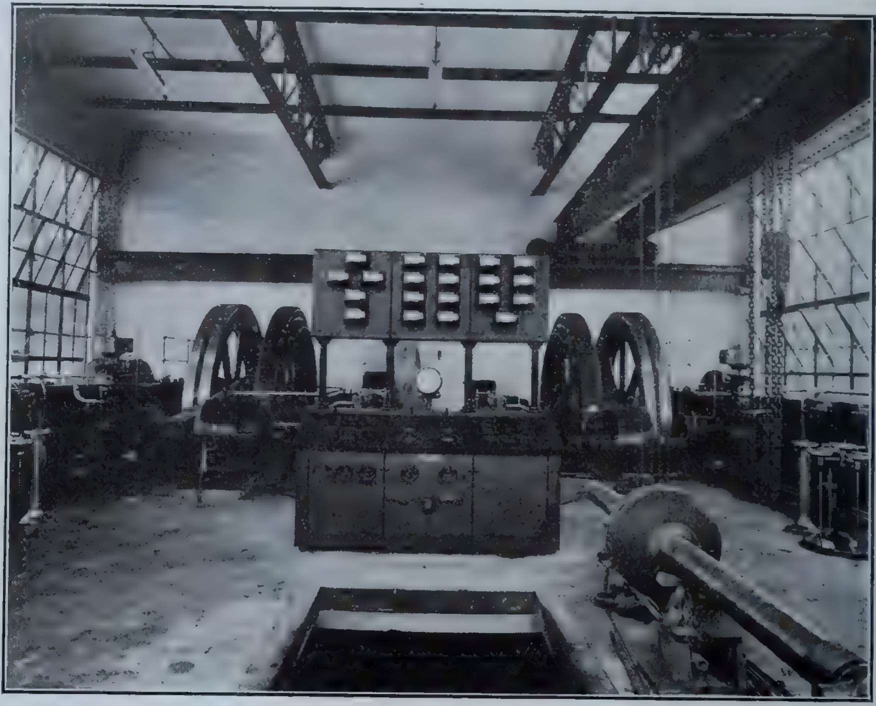
Boiler Room.

The boiler room is located near the power house and is connected to it by an underground passage terminating in the basement. The building is of substantial brick construction, 90x80 ft., and has steel roof trusses with concrete roof. The windows are fitted with "Kahn" steel sash and ribbed glass; a number being made to open, permitting of ample ventilation.

There are installed four Goldie & McCulloch horizontal return tubular boilers of 90 h.p. each, 60 in. diameter by 16 ft. long. The boilers are capable of carrying 140 lbs. steam pressure, but at present are running at 90 pounds. Each boiler is equipped with a set of burners for using natural gas at 11 ozs. pressure. Near the boilers is a Goldie & McCulloch No. 4 "Ideal" feed water heater rated at 125 h.p. and, in connection with it, a duplex boiler feed pump, 5½x3½x6 ins. for boiler feeding. A "Burnham" vacuum pump 16x18 ins. takes the drains from the heating system and returns them to the heater.

In the basement, under one end of the boiler room, are two 6-in. steam turbine double suction centrifugal pumps for pumping hot water from the boilers to the heating coils on the roof of the main factory building. Each pump has a capacity of 1,000 gallons per minute against a head of 50 ft. at 2,500 r.p.m., and is direct connected to a No. 5 Buffalo Forge Co. "Spiro" steam turbine, developing 22 h.p. at 90 lbs. steam pressure, non-condensing. Adjoining these sets is a 1,000 gallon Worthington duplex steam pump for supplying water to the two tanks over the main factory building.

In the boiler room is installed a steam-driven air compressor supplied by the Bury Compressor Co., Erie, Pa. This machine has cylinders 12x12x12 ins. stroke with a capacity of 310 cu. ft. of free air per minute against a pressure of 100 pounds at 200 r.p.m. Under these conditions it is rated at 62 h.p. It is fitted with cushioned poppet inlet and discharge valves, and has forced feed lubrication. All the high pressure steam pipes are fitted with crane extra heavy fittings, and Philip Carey Co. pipe covering is used throughout the plant.



INTERIOR OF POWER HOUSE.

GENERAL VIEW OF PLANT—THE FORD MOTOR CO. OF CANADA, LTD.

INTERNATIONAL MALLEABLE IRON CO.

THE International Malleable Iron Co., Ltd., have built a large foundry at Guelph, Ont., for the manufacture of malleable and grey iron castings, at the eastern end of the city, on a site covering about 12 acres and adjoining the Canadian Pacific Railway tracks. The company is operating under the auspices of the Illinois Malleable Iron Co., of Chicago, Ill., who, in conjunction with W. A. Mahoney, architect, Guelph, were responsible for the lay-out and construction of the plant; they will, therefore, have the benefit of the experience gained in this class of work by the parent company who are one of the largest manufacturers of malleable castings in the United States. The site is level, and being near the railway, every facility is offered for the receiving of the raw materials and the shipment of the product; a siding on the property leads into the stockyard where will be laid an industrial track system, when materials will be conveyed directly into the foundry. The siding also passes along, outside the annealing room where coal is delivered direct from the cars to the annealing oven furnaces, through openings in the wall.

Boiler.

A waste heat boiler has been installed in connection with the air furnace in order to utilize the large amount of heat in the gases leaving the furnace. The boiler is a 400 horse-power vertical water tube unit, built and installed by the Wickes Boiler Co., Saginaw, Mich. The design is especially adapted to its particular purposes, as the floor space required for the boiler and auxiliary furnace is a minimum. Another advantage that tends toward the greatest absorption of heat is the long travel of the gases in close confinement to the heating surface.

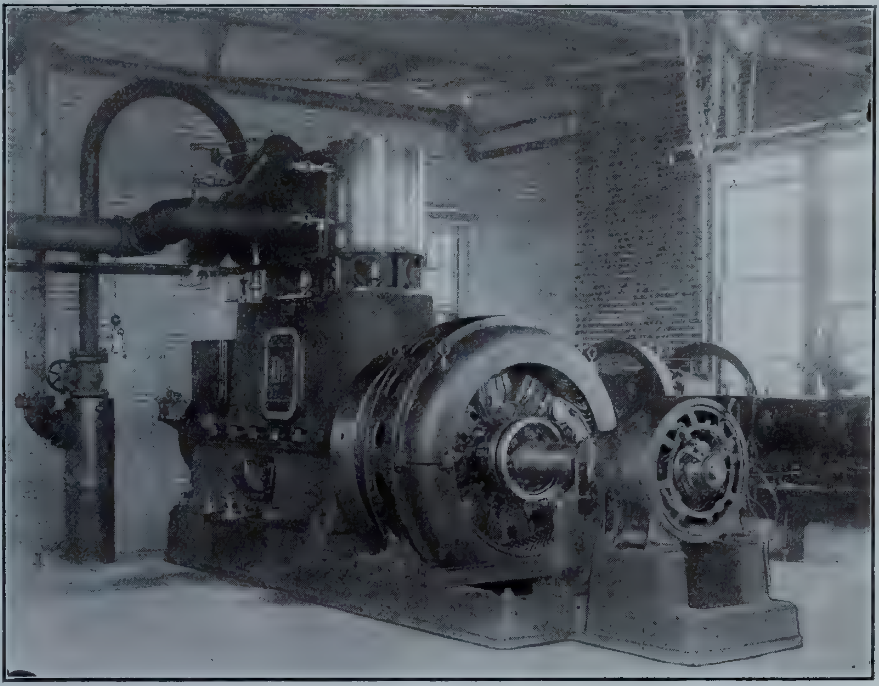
Fire brick dampers are installed at suitable locations to permit the use of the boiler as a direct fired unit in case the steam is desired when the air furnace is down. The auxiliary furnace is hand fired, and will be used to obtain the desired output from the boiler during the charging periods in addition. A waste heat by-pass flue around the boiler to the stack has been provided so that should anything happen to the boiler or boiler setting, it would be possible to take off the heat without damage to the furnace. The total floor space required for the flues, boiler, auxiliary furnace and stack is approximately 25 ft. square. The stack, of perforated radial blocks, is 110 ft. high above top of foundation, and was built by the Alphons Custodis Co., New York. It is 3 ft. 6 ins. diameter at the top, and the foundation of concrete is 15 ft. square by 5 ft. deep. All round column construction is the particular type, and a sectional fire brick lining, 4 in. thick, supported every 20 ft. on the inside by fire brick corbels built out from the main walls, extends throughout the whole height.

The stack is built for high temperatures, the inner core being not only of firebrick, but in addition having the main walls reinforced by internal steel bands built at intervals into the masonry. Between the lining and the main walls there is a 2 in. air space, and each section of lining is built free at the top to allow for expansion under high temperatures. The particular feature of construction is that all the blocks are cut on radial lines to fit the diameter. They are also perforated vertically, the mortar in the horizontal joints entering the holes, keying the blocks, as it were, together. The material is manufactured exclusively for chimney blocks, and has a crushing strength averaging over 6,000 lbs. per square inch.

Power Plant.

The power house contains a "Leonard" high speed engine, rated at 300 i.h.p., running 375 r.p.m., with steam pressure of 125 pounds. It is of the vertical compound type, with cylinders 15 and 20 in. diameter by 10 in. stroke. The engine is totally enclosed, and is equipped with oil relay expansion gear operating the high pressure valve and regulating the cut off in accordance with the engine load. The engine is direct connected to a 150 k.v.a. Canadian Westinghouse generator supplying current at 600 volts, 3-phase, 25 cycles. The 6 k.w. exciter is on the main shaft. The switchboard was supplied by the Canadian Westinghouse Co., and has two slate panels equipped with 3 ammeters, a voltmeter, and the necessary switches.

The air compressor was supplied by the Bury Compressor Co., Erie, Pa., and is of the horizontal simple steam driven type, with cylinders 12 and 12 diameter by 14 in. stroke. Its capacity is 330 cubic feet of free air per minute at 180 r.p.m., against a pressure of 100 pounds, and under these conditions approximately 66 h.p. can be developed. The steam and air cylinders are in a straight line, and have a common piston rod. The compressor has an enclosed crank case, and is fitted with the "Bury" automatic, pneumatic forced lubrication system, designed to increase the efficiency of the machine, and to reduce loss of oil to a minimum. The air inlet and discharge valves are of the cushioned poppet type, rendering the compressor noiseless in operation. The air receiver is 48 in. diameter by 12 feet long, and is situated in the foundry.


"LEONARD" ENGINE AND GENERATOR WITH "BURY" COMPRESSOR.

An "Ideal" feed water heater and purifier is installed, and was supplied by the Goldie & McCulloch Co., Galt. It is an open type heater, 5 ft. diameter by 14 ft. high, and is fed with city water by gravity and heated by exhaust steam from the engine. Feed water is pumped to the boilers by two 7½-4½-10 in. duplex pumps, which were supplied by the Canadian Allis-Chalmers Co. The steam pipes and fittings are extra heavy quality, and were supplied by the Crane Co., Chicago. They are covered with Johns-Manville Co. asbestos pipe covering. A hand travelling crane is installed and equipped with a 2 ton chain block.

Heating System.

The heating system was installed by the New York Blower Co., Chicago, and consists of a 200 in. steel plate motor driven fan, standard for 60,000 cu. ft. of air per minute, together with a heating coil of sufficient capacity to heat the above quantity of air to around 120 deg. through 12,000 lineal feet of 1 in. pipe arranged in two groups. The heating coil is raised to a sufficient height so that the water drains back to the feed water heater. The apparatus is designed for using exhaust steam from the main engine and steam supplied direct from the boiler through a pressure reducing valve. The apparatus operates on low pressure steam at all times.

The buildings heated consist of the main foundry, cleaning room, machine shop, pattern shop, and core rooms. The warm air is distributed through galvanized iron ducts running the whole length of the foundry, with branches leading off at various points for distribution. The fan is located in a separate room near the power house.

CAN. FAIRBANKS-MORSE TORONTO PLANT.

AT the plant of the Canadian Fairbanks-Morse Co., Toronto, hydro-electric power is used, being stepped down at the transformers from 13,200 to 550 volts. The switchboard was installed by the Canadian Westinghouse Co. It has eleven grey marble panels, two only of which are being used at present. The usual equipment of ammeters, voltmeters and circuit breakers furnishes the different panels.

There is a Canadian Fairbanks 40 k.w. 25-cycle, 3 phase, 750 r.p.m. motor generator set for supplying d.c. current at 220 volts to the crane motors. Power is distributed to the motors in the various shops at 550 volts and 110 volts to the lighting circuit. Canadian Fairbanks Co. motors are installed throughout, and Mazda and Sunbeam 200 watt and 400 watt lamps are used for lighting.

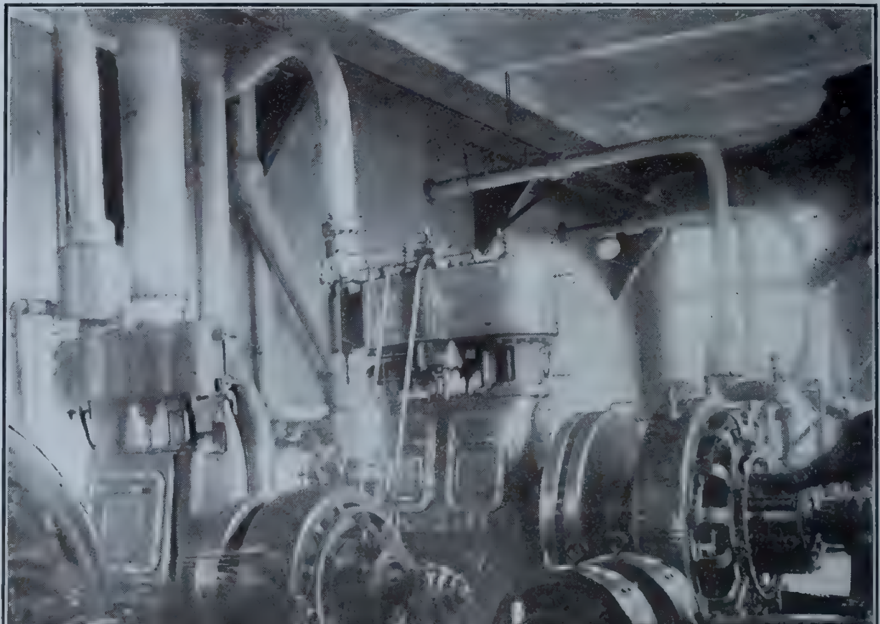
A Canadian Rand air compressor supplies air to the plant. This machine is steam driven, having cross compound steam and air cylinders, the steam cylinders being 11 and 18 in. diameter, and the air cylinders 16 and 9 in. diameter, by 16 in. stroke in both cases. The compressor has a capacity of 744 cub. ft. of free air per minute against a pressure of 100 pounds at a speed of 200 r.p.m. A Canadian Fairbanks 6-8-12 vacuum pump takes the drains from the heating coils and returns them to a Cochrane feed water heater. Two Canadian Fairbanks 6-4-6 boiler feed pumps are also installed.

In the boiler room is a battery of four boilers which consists of one 150 h.p. Babcock & Wilcox water tube boiler having a working pressure of 150 pounds; two "Brownell" return tubular boilers and one return tubular boiler by the John Inglis & Co. The three latter boilers are of 75 h.p. each, and have a working pressure of 70 pounds. The steel stack is 100 ft. high by 40 in. diameter. At the back of the boiler room is the coal storage.

CANADIAN LOCOMOTIVE CO., KINGSTON, ONT.

THE works of the Canadian Locomotive Co., Ltd., at Kingston, Ont., are the oldest in Canada devoted to locomotive construction, dating back more than sixty years. They were established in 1850 and were taken over by the present company, organized by Mr. Aemilius Jarvis, of Toronto, in 1911.

A large amount of money has been spent in the modernization of the plant, and where the production two years ago was barely six engines per month it is at the present time twelve; and when the improvements and betterments which are now being proceeded with are completed, the output will be increased to twenty-five locomotives per month.



INTERIOR OF POWER HOUSE, SHOWING ENGINES AND GENERATORS. CANADIAN LOCOMOTIVE CO.

The problem of how best to remodel the works was one beset with difficulties, not the least of which was the restricted nature of the site of the existing plant. This site, however, it was decided to retain, as it is possessed of several important advantages. It has excellent track connections with the Grand Trunk Railway and lies on the shore of Lake Ontario, with unloading slips on two sides of the plant, enabling raw material to be brought in by water.

The first step in rebuilding was to get out plans for the new shops to be erected over and around the old ones, that being the only way in which production could be continued during the alterations. This work was entrusted to the firm of Henry Goldmark, consulting engineers, New York. The preparation of detail plans and specifications and the carrying out of the work is in charge of Mr. C. J. Goldmark, a member of the firm. Good progress has been made, the new carpenter and pattern shop, pattern storage, foundry, tank and tender shops being now completed. The pits in the new erecting shop are also built and the foundation work finished; and erection of the steel work is now going forward.

The Power House.

Current for operating these shops is generated in the Company's own power house, erected about eight years ago. It is situated east of the new foundry and is a steel framed building covering an area of 87 ft. by 75 ft., with an annex for the pumps and other auxiliaries. The walls are of reinforced concrete and the flat roof is of hollow tile. A longitudinal fire wall divides the boiler room from the engine room, the former having a width inside of 37 feet 8 inches and the latter 32 feet. Steam at 150 lbs., pressure is raised in six Wicks vertical water tube boilers fitted with Foster superheaters. Four of the boilers are rated at 250 h.p. each, and two at 330 h.p. All are fired by Murphy automatic furnaces in Dutch oven settings. There is a short steel stack 6 feet in diameter through which a draft is induced by a Canadian Buffalo Forge Co. engine driven fan. This installation is in duplicate to avoid breakdowns.

The Dutch oven setting of the furnaces makes the coal handling problem a very simple one. To the south of the power house is an elevated coal bunker, which is filled by a locomotive crane from the yard coal piles or direct from a steamer at the adjacent wharf. An elevated industrial track runs from below this bunker into the boiler house and across the top of the Dutch ovens. Small tip wagons are thus quickly filled up at a chute in the bottom of the coal bunker, run into the boiler house and dumped direct into the furnace hoppers. On their way they pass over a small track scale and are weighed. At present ashes are raked out of the pits by hand and taken away in wheel-barrows; but it is the company's intention to shortly instal an ash disposal system on the suction principle.

The engine room has a dado eight feet high of white tiles, which gives it a very pleasing appearance. It is equipped with a hand operated 5-ton traveller and is lighted by arc and tungsten lamps. There are three generator units with a total nominal capacity of 750 kilowatts. The engines are all by Belliss & Morcom, and the generators by the Canadian Westinghouse Co. These generate direct current at 250 volts.

Compressed air for the whole plant is supplied by two compressor units. One of these is a Belliss & Morcom vertical cross-compound two-stage compressor with a capacity of 2,000 cubic feet of free air per minute at 100 lbs. pressure when running at 250 r.p.m. The second unit is a Canadian Ingersoll-Rand horizontal cross compound Corliss two-stage compressor 1,250 cubic feet capacity per minute at 100 lbs. pressure, running 96 r.p.m. The exhaust from all five units can be discharged to the atmosphere, to the shop heating system, or to a Worthington barometric condenser. A vacuum of about 27 inches is maintained in the latter by a 6-12-10 Knowles vacuum pump, while the condensing water is raised by a No. 8 single stage turbine pump built by the John McDougall Caledonian Iron Works Co., Ltd., Montreal. This is direct driven by a Robb-Armstrong single cylinder vertical engine.

The boiler feed is delivered by two Blake and Buffalo steam pumps, 10-5-10. The water is drawn from Lake Ontario and after passing through a Webster open heater is measured by an automatic recording Venturi meter and is thus checked against the coal, which as previously stated is all weighed. The boiler feed lines are in duplicate, and, as a precaution against the failure of both feed pumps, two No. 9 Korting injectors are always available.

For general water service there is a 10-7-2 steam pump by the Canada Foundry Co.; and the same firm built the two fire pumps, the larger of which is a 20-12-6 and the other a 16-9-12. For handling the returns from the heating system there are two Burnham 10-16-16 vacuum pumps, which deliver to the heater or to sewer as may be desired.

The engine room contains a handsome marble switchboard of ten panels, and each shop has its own feeder line controlled from a separate panel in the switch-board, the whole of the motors throughout the plant operating at 240 volts. To maintain an even voltage in the lighting circuits there is a motor generator balancing set of 10 kilowatt generator capacity.

From the power house a pipe tunnel runs across the site as far as the old machine shop. This accommodates the high and low pressure steam pipes, water service pipes, etc.

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PROTECTING BELTS, SHAFTS AND PULLEYS.

THE accompanying instructions have been issued by a Chicago concern relative to the prevention of accidents due to contact with moving belts, shafts and pulleys:—

Belt, rope and cable transmission shall be arranged, so far as possible, to be easily guarded.

Pipe or angle railing placed 18 inches from the pulley or belt shall be provided where there is little danger of anyone getting caught by the belt.

Wire-mesh or perforated-plate casing shall be provided where the location of a belt is such that persons are liable to get caught between the belt and the pulley.

Where the belt is located in such a position that, should it break, flying ends will strike persons passing by the belt, it should be inclosed by a suitable guard.

The full width of a belt should be allowed between two pulleys or a pulley and a hanger on shafting so as to prevent the belt from becoming wedged and possibly pulling down the line shafting.

Belt splicing shall be made so as to eliminate ragged edges or projections which might catch employees' clothing. Endless belts are recommended, especially for high-speed machines.

Belts should be inspected frequently and kept in a condition to avoid accidents. Tight belts should be avoided.

Wherever it is necessary to shift belts, a mechanical device should be provided.

Where it is necessary to unship a belt, a hook or belt-perch should be provided to prevent the belt from resting on the shaft.

Shafting not over 12 inches above floor should be covered.

Shafting over 12 inches and not over 7 feet above floor should be encased or railed off.

Exposed ends of shafting shall be encased or otherwise guarded.

Overhead shafting which must be oiled should be equipped with a walk for the oiler, if practicable.

Electrically driven shafting should be provided with a safety switch, to be used when men are working on it. This switch should be placed at the top of the ladder or in some place where no one will tamper with it.

Shaft couplings should be guarded where safety couplings are not used.

To prevent gears or pulleys from working off the ends of shafting, shaft ends shall project at least the diameter of the shaft beyond the hub of the gear or pulley, so that the key can be locked in place.

Hangers for shafting shall be particularly strong and well secured.

All projecting keys in shafting, when exposed so that a person might get caught thereon, shall be guarded or cut off.

Wherever possible, cotter pins or spring washers should be provided to prevent nuts from working off the ends of bolts.

Setscrews must be guarded, countersunk or placed in safety collar with flanges high enough so that the setscrew head will not project above the flange.

Because of the dangers incident to hoisting material by means of line shafting, it is forbidden that any hoisting be done in this manner. All hoisting shall be done either with hand tackle and block, or with regular hoisting machinery.

❖

Estevan Lignite.—R. M. Blackburn, chief inspector of boilers for Saskatchewan, will leave shortly to conduct experiments with Estevan lignite coal at the plant of the Dominion Coal Co., Sydney, N.S. He will be accompanied by S. N. Darling, who is in charge of the Government experimental plant at Estevan, and the tests will probably cover the better part of two weeks. Three weeks ago, two carloads of carbonized screenings from the Estevan mines were shipped to the East, and this fuel is to be used in determining the efficiency of the fuel in a special type of furnace, only two of which are in operation in this country, and both at Cape Breton.

Changing From Oil Fuel to Coal For Steam Boiler Firing

By F. V. Hetzel*

General observations intended to throw some light on the methods to be adopted when installing coal and ash-handling machinery equipment in boiler plants which have been previously burning oil. Individual peculiarity of location and arrangement will call for particular treatment and the service of engineers trained to the special work.

WITH the rise in the price of fuel oil, many power houses are facing the problem of burning coal instead of oil. Heretofore, these power houses favorably situated near oil fields have obtained their oil at low cost, but oil prices have been going up so steadily that many managers have come to the conclusion that it will pay them to make the alterations in their boiler houses which a change in fuel makes necessary. Boiler settings must be altered, flues and stacks made larger, and provision made for storing and handling coal and ashes. After the simplicity of piping oil to the boiler furnaces, taking care of coal and getting rid of ashes is a disagreeable necessity, but with the wide-spread use of conveying machinery, coal and ash-handling equipments for boiler houses have been brought to a state of refinement, and managers who are facing this problem will find that such apparatus can be adapted to any conditions of site, size of boiler house, or amount of storage.

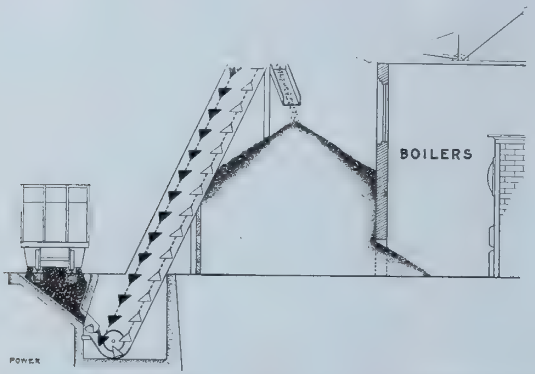

FIG. 1—WHEN THERE IS NO ROOM FOR OVERHEAD STORAGE.

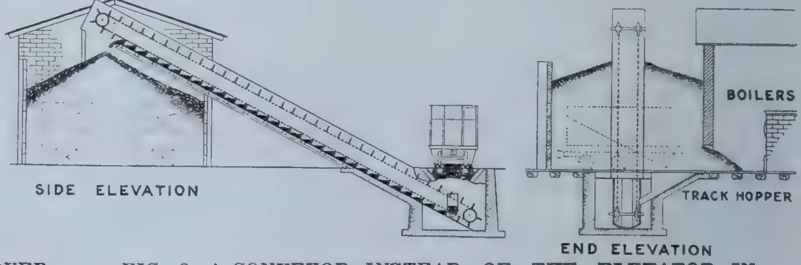

FIG. 2—A CONVEYOR INSTEAD OF THE ELEVATOR IN FIG. 1.

Assuming that there is a railroad siding at the plant, it will be found advisable in most cases to put in a track hopper with a conveyor or an elevator, rather than build a trestle, and dump cars on it. If a trestle dump is used, the coal is spread over a considerable length, and the fireman has to do more wheeling and shoveling to get his coal. Moreover, the first cost of a trestle, and the expensive maintenance of a wood trestle, generally offset what may appear at first as desirable simplicity.

For a hand-fired boiler plant, it is often convenient to store coal just outside the wall of the house, and let the coal flow through holes in the wall to within reach of the fireman. This may suit existing plants when there is no room for overhead storage. In such cases a bulkhead is built parallel to the wall of the house, and the intervening space filled by a chute from the head of an elevator, Fig. 1, or from a conveyor, Fig. 2, or by means of a combination of elevator and conveyor, Fig. 3. The machinery for such a plant is simple and cheap, and the cost of unloading from cars and delivering to bins need not exceed 2 cents a ton.

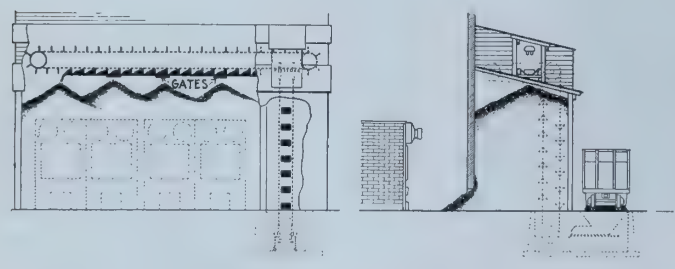

FIG. 3—A COMBINATION ELEVATOR AND CONVEYOR.

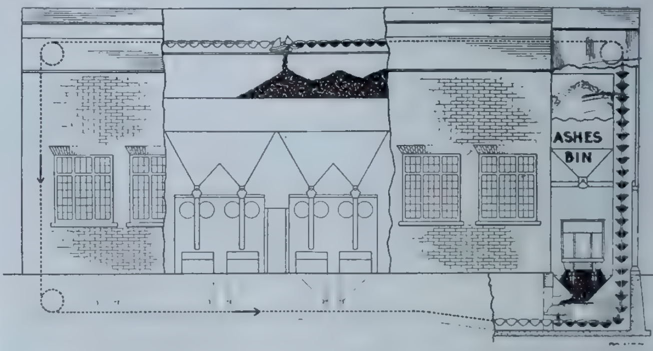

FIG. 4—TYPICAL INSTALLATION OF PIVOTED BUCKET CARRIER.

For every 100 tons of coal burned, there does not usually result more than 10 tons of ashes, and for a small house, it does not pay to install a separate conveyor to gather ashes from in front of the boilers. A wheelbarrow or a hand cart is usually best. An ash elevator and a storage bin are often used, Fig. 5, in such plants. The ashes are stored at a height to flow by gravity into cars or carts, and as they are handled but once, there is no need for the extra labor of loading, as is the case where ashes are piled on a dump until the time comes to take them away.

Since one man cannot fire more than 500 h.p. of boilers under normal conditions, it becomes necessary in larger plants to employ more firemen, or to install stokers and a gravity supply of coal from overhead storage. It may not be possible in all altered boiler plants to install overhead bins and spouts, but where it is possible, managers should consider not only the first cost of bins and conveyors, but also the fact that the wages of common labor are increasing each year, that in many places it is difficult to hire men for the hot and laborious job of firing boilers by hand, and that it generally pays to invest $5,000 in bins and conveyors for every fireman or coal passer whose services can be rendered unnecessary.

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*Chief Engineer, the Link Belt Co., Philadelphia and Chicago.

If overhead storage is decided on, the bins can be separate for each boiler, or one long bin can be used. The latter is the cheapest way to get a large amount of storage, particularly if the bin is of the suspension or bag-bottom form. The bin should be high enough to permit boiler tubes to be cleaned or removed, and there should be room enough over the bin to put in the coal conveyor. The bin can be filled by a separate coal conveyor, but since in most large plants the problem of quickly disposing of ashes is an important one, a convenient way is to combine the coal conveyor and the ash conveyor in one, and use a machine of the pivoted-bucket type. Figs. 4 and 6 show typical installations of pivoted-bucket carriers. These include a track-hopper dump, a feeder of some kind, a crusher and the carrier taking coal from the crusher and delivering it to the overhead bins, or taking ashes from the hoppers under the boilers and delivering them to the ash storage overhead. If there is no basement for the lower run of the carrier, or if hoppers cannot be built under the boilers, all that is necessary is a trench in the boiler-room floor to receive the carrier. Ashes are then raked from the boiler ashpits into the lower run of the carrier.

Pivoted-bucket carriers are of several forms. A type quite commonly used has overlapping lips, see Fig. 7, to prevent the spill of material between the buckets. Cams or strikers on the ends of the buckets engage a dumper which travels along the top run, and the contents of each bucket are poured out at any point desired.

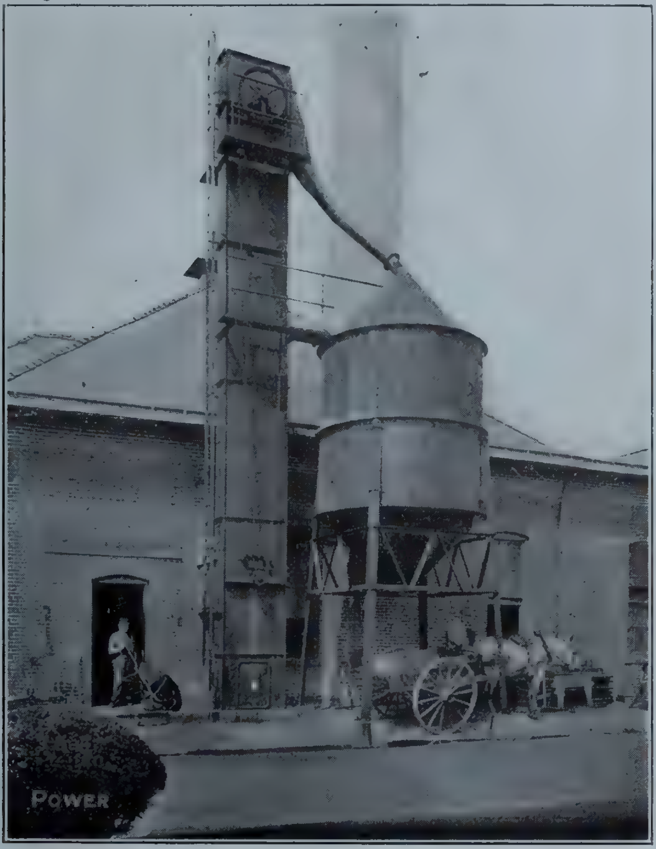

FIG. 5—ASH ELEVATOR AND STORAGE BIN.

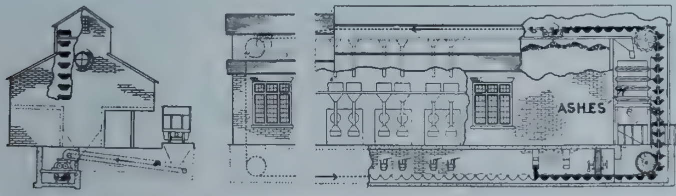

FIG. 6—AN INSTALLATION SIMILAR TO THAT OF FIG. 4.

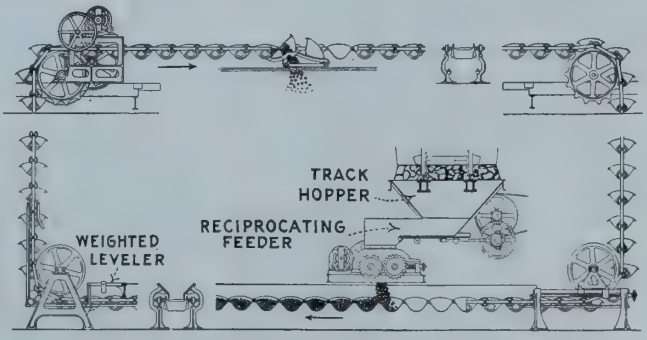

FIG. 7—A FORM OF PIVOTED BUCKET CARRIER.

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The Morrison Water Tube Boiler is illustrated clearly in a bulletin recently issued by the Morrison Boiler Co. Sharon, Pa. One page contains a schedule of information which the company require before submitting quotations.

ROLLER AND BALL BEARINGS.

At the Institution of Automobile Engineers recently, Professor John Goodman, of the Leeds University, gave a lecture on the subject of roller and ball bearings. Professor Goodman has been making a consistent study of this question for fifteen years, in the course of which innumerable experiments have been made on various types of both ball and roller bearings under many different conditions of load and at various speeds.

Before dealing with the various criticisms he made, it may be well, says The Engineer, to give one of the most valuable results to which his investigations have led, namely, the establishment of a formula which will give the maximum working load in pounds to be allowed for any given ball bearing. The formula reads:—

$$\frac{K\,m\,d^3}{N\,D + C\,d}$$

where

m = the number of balls in the bearing,
d = diameter of the balls in inches,
N = revolutions per minute,
D = diameter of ball race, diameter being taken from the point of contact of the ball with the race, or for a thrust bearing D = the diameter taken from the centres of the balls.

The constants C and K are as follows:

For Thrust Bearings.

	C.	K.
Flat races	200	500,000
Hollow races	200	from 1,000,000 when the radius of the race is about twice that of the ball to 1,250,000 when the radius of the race is 9-16th that of the ball.

For Journal Bearings.

	C.	K.
Flat races	2000	1,000,000
Hollow races	2000	from 2,000,000 where the radius of the race is about twice that of the ball to 2,500,000 where the radius of the race is about 9-16th that of the ball.

Roller Bearings.

The lecturer dealt first with the question of roller bearings, and commenced by showing Osborne Reynold's diagram illustrating the manner in which the resistance due to friction occurs. The first point he impressed upon his audience was that when an elastic roller rolls on an elastic bed there is always slipping, and his tests show that the amount of slipping depends very largely upon the load, i.e., there is a small amount of slip with a very light load and a comparatively large amount of slip with a heavy load.

In the case of roller bearings, end thrust results in the rollers wearing right through the end of the cage, and, in addition, sets up a vibratory action, which enormously increases the friction of the bearing. A case was mentioned in which this vibration was so large in a particular factory that the bottles on the shelves of the chemical department overhead began to fall over, and the bearings had to be removed. End thrust, it was pointed out, may easily amount to a quarter or a third of the total load on the bearing. With a 10-ton load on a bearing, from 2¼ to 3 tons end pressure would be encountered, and the direction of the end thrust would always reverse when the direction of the rotation of the shaft was reversed. The case was also mentioned of forty or fifty railway wagons fitted with roller bearings which had to be put out of service owing to the amount of end thrust which in some instances had caused the casing to be worn right through.

This end thrust with roller bearings occurs however good the workmanship, although one form of roller bearing was illustrated in which the length of the roller was approximately equivalent to the diameter, and, whether due to this fact or not was not stated, the end thrust was almost absent. Comment was made upon the satisfactory service given by the plain roller bearings used in light railway wagons of the Koppel type, the bearings being practically pieces cut from mild steel rods with the ends rounded. The results obtained with this very cheap form have, curiously enough, been found to be almost equal to those of the most expensive type of roller bearing.

Professor Goodman also investigated the question of whether the efficiency of roller bearings was in any degree affected by the degree of accuracy in the workmanship, but he has come to the conclusion that it is not so, because, after going to the fullest possible trouble to obtain bearings of the highest class, the results obtained were no better than with the cheaper forms. Better results were achieved with long rollers, but these, he said, could not be regarded by any means as an unqualified success.

Summing up end thrust troubles, Professor Goodman said that the friction on the bearings was enormously increased, owing to end thrust. He could give many instances of the seriousness of the wear, and in addition there was the question of rumbling or vibration. With a properly designed roller bearing in which the end thrust was extremely small, the friction was, to all intents and purposes, independent of the lubrication, but when a large amount of end thrust manifested itself, then lubrication made a very considerable difference, for the simple reason that when there was little end thrust a pure rolling action was obtained, whereas with end thrust there was a large amount of friction between the ends of the cage and the flange of the casing. In these instances lubrication did good.

Friction with roller bearings has been determined to be almost independent of the speed, and in all roller bearings, bad and good, the starting effort is very little greater than the running effort, which was admitted to be a point in their favour for machinery constantly starting and stopping. With the worst type of roller bearing the friction was lower than in an ordinary bearing with poor lubrication, but a roller bearing in these conditions was not so good as a bearing running in a bath of oil.

Ball Bearings.

Passing on to the virtues of the ball bearing, the lecturer pointed out that with it there is no end thrust at all, and the friction is very much less than in the majority of roller bearings; hence, there was a good deal to be said in its favor. It might be said against this statement that a ball bearing only bears on a point, whereas the roller bearing bears on a line; hence, a ball bearing of a certain size could not possibly carry so high a load as a roller bearing.

He admitted that there was an element of truth in this, but it was not the whole truth. With equally good material in rollers and balls, and in the absence of end thrust on the roller bearing, the argument would hold rigidly, but since end thrust did come in with the roller bearing, with other troubles in consequence, practically any type of ball bearing was able to carry a much bigger load than any roller bearing.

Features of Interest Relative to Boiler Firing*

By W. M. Faber **

The author in his paper takes the stand that hand-firing if properly directed and performed, is not without its many good points, but as the matter of performance usually falls far short of the ideal, mechanical stoking along chain grate lines is recommended on account of its tried efficiency.

THE man with the shovel is told by the expert to fire in a manner called the "coking method," and, if reasonably intelligent, he soon finds that he is putting the coal through a cycle of operations by which the volatiles are first distilled and driven off, largely by radiant heat from the side walls and arch if it be an extension furnace, and from the incandescent fuel farther within the furnace; burning the resultant coke by a proper admixture of air through the grate bars and finally riddling the ashes into the ash pit at the middle and back section of the furnace, when the grates are as they should be for this method of firing, of the sectional agitating or shaking type.

By so firing, it is possible to get a high furnace efficiency, but it only applies to furnaces equipped with non-automatic grates where hand firing is practised. Even in plants thus equipped, we have trouble because the fireman seldom follows the instructions given him and soon gets back to his old method, which, in most cases, is what is called the spreading system of firing. This is good if properly followed out, but as usually done, it is a source of great waste of fuel, because the fireman persists in firing five or six shovels of coal where three would have done very much better, presumably so that he might sit down between firings for 15 or 20 min.

The Chain Grate Stoker.

Fundamentally, it seems to me, the idea of the chain grate stoker is correct. It carries the coal through the same cycle that the intelligent fireman does when he uses the coking method on a flat grate, and if we could only control the air supply more perfectly and hold the fuel on the grate long enough to insure a thorough burning out, its efficiency would be greatly improved. When chain grate stokers are used, we have come to appreciate that there are certain requirements as regards the physical condition of the coal, aside from its thermal qualifications, that we must consider and provide means for obtaining; an important one being, proper and approximately uniform size of the coal that comes to us either as slack from the mines, or from our crushing plants when run-of-mine is used.

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*From a paper read before the Cleveland Engineering Society.

**Engineer, the American Steel & Wire Co., Cleveland, Ohio.

Formerly when run-of-mine coal had to be crushed, we considered it in good condition when 85 to 90 per cent. would pass through a 1¼ x 1¼-in. mesh screen, but at the present time we are dissatisfied with this condition of the coal for our stokers, and are endeavoring to get our crushers to crush the coal so that 85 to 90 per cent. will pass through a ¾ x ¾-in. screen. These changes in the mere matter of the sizes of the lumps of coal that make it fit for chain grate stokers have been brought about by the attention that seems to be paid everywhere to the combustible in the ash that is discharged from the chain grate stoker.

Some years ago we appreciated the great loss in unburnt coal thrown away in the ashes, the percentage of the combustible in the ash ordinarily running as high as 35 to 55 per cent. An attachment was designed to hold this partly burnt-out fuel in the boiler furnace after it had left the chain grate. The partly burnt-out coal was thrown over into an auxiliary furnace grate where it was kept until thoroughly burnt out, when the ashes were delivered into the ash pit by the action of a clinker bar driven from the stoker drive. Unfortunately, after two or three promising attempts this effort at improvement was abandoned.

Air Supply.

To provide a sufficient air supply under the ignition arch when a coking coal is used, the method of introducing air as shown in the illustration has been used with reasonably good success. Primarily, the introduction of air at this point was used to prevent smoke when using certain grades of coal that coke readily, and the results seemed so promising that tests were made of resultant gases, both with and without the blower. These results are as follows:

	With blower	Without blower
Draft	0.40 in.	0.42 in.
CO_2	10.4 per cent.	9.9 per cent.
O	8.4 per cent.	8.8 per cent.
CO	0.0 per cent.	0.0 per cent.

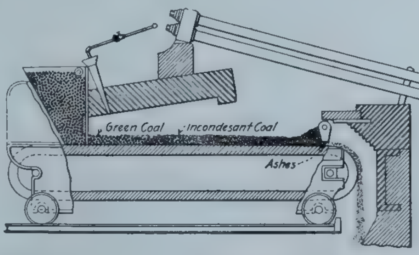
From careful samplings of the ashes discharged from chain grate stokers in a number of boiler houses, we have found that the percentage of combustible averages from 40 to 50 per cent. We think this combustible should be cut down to an average of 15 to 20 per cent.; which means in a boiler house using 50,000 tons of coal per year of 12 per cent. average ash, that there would be a saving of some 1,500 tons of coal.

Water Back Necessary.

Notwithstanding the fact that we are accomplishing a great deal by getting more uniformity in the size of the coal that comes from our crushers, we are going a step farther in providing our chain grate stoker furnaces with a water back of improved design. This water back is shown in the cut. It is hung on trunnions so that it may swing easily when large pieces of clinkers have to be discharged from the chain grate into the ash pit. Ordinarily, this water back when hanging vertically is set from 1 in. to 1½ in. above the chain grate stoker, and when coals that do not clinker badly are used, it acts as a skimmer, allowing the thoroughly burnt-out ash to be discharged into the ash pit, holding the balance of the more or less burnt-out fuel until it has time to be consumed. Results of tests on stokers equipped with this improved water back have shown a saving of 3 per cent. over stokers with the older type.

Furnace Efficiency Standard.

The standards of boiler furnace efficiencies must be established by the minimum amount of combustible left unconsumed that it is practicable to get by simple devices that will have great durability and that are effective for the particular purposes used; by the maximum possible amount of carbon dioxide without the ever-present danger of loss through lack of air supply, resulting in incomplete combustion, and a more or less high percentage of carbon monoxide and unconsumed hydrocarbons, also by a minimum radiation through the walls of the furnace itself. The best practice has shown that, when using the grades of coal mentioned, 12 to 13 per cent. of carbon dioxide and 15 to 20 per cent. combustible in the ash are good averages to strive for in continuous practice.



SCHEME FOR ADMITTING AIR AND HOLDING PARTLY BURNED FUEL IN A CHAIN GRATE STOKER.

Discussion Notes.

In the course of the discussion following the paper, Mr. Joseph Harrington said that recent experiments in quite a number of installations have developed a design of arch which he has termed the reflecting arch. This is a long inclined arch so placed that the heat from the rear or incandescent portion of the fuel bed is directly reflected to the incoming fuel at the gate. It is quite possible to place this arch so that the maximum amount of reflection shall take place. Its height and inclination, moreover, render it possible to utilize for ignition purposes, the direct radiation from the face of the bridge wall. This is no inconsiderable part of the programme, it being of the utmost value even though it may be anywhere from 9 to 12 ft. away from the gate.

Satisfactory ignition with the grate speeds up to 10 or 12 in. a minute, he said, can readily be attained, which corresponds to a rate of combustion exceeding 50 lb. per square foot. These high rates of combustion can only be attained with fuel bed thicknesses which will permit of the application of high draft. As the fuel bed thicknesses increase by virtue of increased furnace draft, greater extraction of oxygen can be accomplished, so that with other conditions the same, gas analysis of increasing merit can be secured. A high furnace draft, however, is accompanied in the usual setting by increased infiltration so that the result under ordinary conditions is not all beneficial.

Mr. Harrington expressed himself as a strong advocate of the use of recording instruments in the boiler room. The use for example of a recording draft gauge in the furnace, he said, will indicate every time the operative opens the inspection door and the time that it is open. It will tell whether or not he has allowed the fire to burn short or to acquire a bank. It will tell whether he is feeding his fuel too heavy or too light, and if this is backed up by a CO_2 chart and damper draft with a recording thermometer in the uptake, the man in the office the day after, can tell what the conditions were in his boiler room far better than he could had he lived in that boiler room through the entire previous day without the use of these instruments.

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The Turbine Equipment Co., Toronto, and New York, have been awarded a contract by the town of Brockville, Ont., to supply a three million gallon De Laval centrifugal pump direct connected to a 200 h.p. De Laval steam turbine, the combined unit to operate against a domestic pressure of 75 pounds per sq. inch, and to give a pressure of 110 pounds per sq. inch for fire purposes. They have also secured the order for a three million gallon De Laval centrifugal pump direct connected to a 200 h.p. Canadian Westinghouse synchronous motor for operation againts a domestic pressure of 75 pounds per sq. inch.

Boiler Deposits, Their Frequent and Thorough Removal--1

By a "Vulcan" Staff Officer *

Attention is directed in this article to the necessity for providing not only suitable apparatus for the treatment of feed water before it enters the boiler, but for unceasing attention being given through examination and otherwise to the removal of such deposits as may evade the treatment medium and find lodgement on the different interior surfaces.

EVERY boiler owner is aware of the necessity for frequent cleaning of each boiler and its surroundings, but the absolute importance of this work is not always so fully realized as it ought to be. We therefore propose to deal at some length with this question; first, as to the reasons by which such necessity arises, and second, as to the conditions under which the work should be carried out.

The most obvious reason for cleaning arises when the boiler is found to be absolutely unable to perform its required work on account of the deposit of scale inside, and of soot or dust outside the boiler and inside the flues. This condition is occasionally met with, but comparatively seldom in present practice. In any case, the neglect is attended with severe penalties, and if sufficiently powerful chimney draft or mechanical draft is available, a condition of grave danger rapidly supervenes. If it be often repeated, it is attended with speedy deterioration or practical destruction of the boiler.

The effects of wear and tear are noticeable in very different degree in separate cases where the conditions might be expected to be equal. Many reasons may contribute to affect the results, but one of the most important differences will be usually found in regard to the frequency and thoroughness of the cleaning and general attention which the respective cases receive. Neglect of this kind is invariably attended with undue depreciation and large expenditure in repairs.

Boiler Deterioration.

Notwithstanding the utmost degree of attention, boilers must and will deteriorate structurally more or less, continuously from the first day of working. It is impossible to predict either the amount or the precise character of this deterioration, and therefore frequent thorough examination is necessary in order to reveal any defects before they approach a dangerous stage. All boiler owners of repute have long arranged such examinations. The duty is, however, usually discharged by the employment of an engineering insurance company of standing and repute who specialize in this class of business.

Boiler deposit is for the greater part sparingly soluble mineral matter which has been dissolved, or other matter which is suspended in the water. This water is fed to the boiler, steam is produced, and the solid matter remains in the boiler. A very good feed water may contain about ten grains of such solid matter per gallon. If each pound of coal burnt in the boiler evaporates 8 lbs. of water ,and if the total consumption of coal per week amounts to 25 tons, then 64 lbs. of solid matter would be left in the boiler per week of ordinary work.

In good practice, an important proportion of the solid matter is removed by the judicious use of the blow-off cock, but much remains in the boiler to be removed manually when the boiler is laid off for the purpose. During periods of drought, the water contains more solids than at other times, and moreover the apparent waste of water at such times by blowing off is liable to lead to neglect, and cause accidents.

The presence of accumulated solid matter in the water is attended with increased resistance to the transmission of heat from the fuel in the furnace to the water in the boiler, and therefore with serious loss of efficiency. Such resistance, moreover, causes overheating of the plates and other structural parts, which, if continued, induces straining, grooving, and other damage by which the life and working value of the boiler are vitally affected.

Feed Water Treatment.

The solids in the water may exist as soluble matter, in which case the water remains clear, or the whole or some part may be insoluble, in which case the water is turbid or cloudy. Floating objects, leaves and grosser impurities, are removed by a strainer. If the turbidity is very intense it may be reduced by treatment in a settling tank, and finally passing through a filter, of which many designs are available for feed-water treatment.

In most of the manufacturing districts the public water supply is of such a quality that it may be used in boilers with complete confidence without treatment. In other important districts the water may not be inferior in regard to dietetic or culinary purposes, but it contains too much dissolved solid matter to be freely used in boilers without previous treatment. In some districts it has been found that the diversion of sewage from the river and the adoption of purification processes has been attended with great increase of difficulty in connection with the use of the water for boilers. As a rule waters containing up to 13 grains of dissolved solid matter per gallon may be used without treatment as regards liability to incrustration; and this allows a wide margin to the good in the majority of the waters in question. Very simple treatment may, however, be required to correct liability to cause or promote corrosion.

Water Softening Equipment.

The great majority of the substances contained in the water impart a condition known as "hardness," which in relation to domestic purposes is chiefly important because it increases the amount of soap required in connection with washing operation. The purification plant required for such elimination is usually termed a "softening plant." Many designs of such plant are available, some one or more of which may be confidently expected to successfully deal with any combination of conditions. Exhaustive treatment of the chemical principles involved in water softening cannot here be attempted, but the chief points—principally physical—may be briefly explained. These points are selected principally by way of illustration, and are not in any way exhaustive. The question is also proposed to be treated at greater length in an early issue.

The principal mineral substances to be dealt with in this way are salts or chemical combinations of bases with acids. The principal bases are the oxides of calcium, magnesium, and sodium. The salts of calcium and magnesium are sufficiently soluble in water to cause trouble in connection with a boiler when supplied with water containing them; but the sodium salts without exception possess a very much higher degree of solubility than the calcium and magnesium salts. Brine is a saturated solution of common salt, and is pumped out of the ground in salt districts. Small quantities of common salt are also occasionally found in well water in other districts. Sulphate of soda is occasionally found in large quantities in feed waters, particularly in mine waters, and sodium bicarbonate is also sometimes present.

In a commercial water-purification plant, the calcium and magnesium salts are treated by the addition of chemical re-agents, the chief of which are quick or caustic lime and sodium carbonate. The action of quicklime may be broadly described in application to a case in which one part of lime is held in solution by two parts of carbonic acid; and a second part of lime is applied in the form of lime solution or, with a less degree of accuracy, as milk of lime. The additional lime captures one-half of the acid, thereby effecting the precipitation of the whole of the lime, original and superadded. In this case the lime carbonate is removed by precipitation. Only calcium carbonate is left in solution to the extent of its solubility in water, per se. The treatment of the permanent hardness involves an exchange of acids, so as to change the lime to an insoluble condition. In other cases the action is more complicated, but in all cases the soda remains in solution and the calcium or magnesium is rendered insoluble.

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*The Vulcan Boiler and General Insurance Co., Manchester, England.

Complete Purification Equipment.

The complete purification plant comprises apparatus for the supply of water and reagents in accurately measured proportions; also means for effecting prompt and thorough admixture of the same; space to contain the mixture under conditions of time, quiescence, and temperature, to ensure true and full completion of the required chemical reactions, a settling chamber in which the bulk o fthe solid residue is deposited; also where necessary, a filter arrangement is added for the removal of that part of the solid matter which escapes interception in the settling tank or chamber. An apparatus constructed on these lines, maintained in perfect order, and operated in accordance with the nature of the solid matters dissolved in the water will eliminate all the most objectionable constituents which are usually found in water which is available for feeding boilers.

In connection with the use of good water, purification is not required, and in the great majority of cases complete simplicity would be assured if the water could be conveyed to each works from the hills uncontaminated as is done in case of public supply. This is only possible to a limited extent in connection with private supply for boilers, and in most cases the water must be taken from the stream after having been repeatededly used, probably concentrated and rejected; also after receiving pollution in various degrees of quantity and quality. The impurities, moreover, vary from time to time, thereby causing difficulty in adjusting the reagents to accord with the amount of impurity.

Blowing Off.

In all cases boilers at work should be frequently scoured by opening the blow-off cock for such a length of time as may be required to prevent the accumulation of solid matter and soluble salts within the boiler. It is difficult to state precisely how long the cock should be kept open, but obviously this will depend upon the amount of material accumulated, as well as the frequency and the freedom of discharge through the cock and waste pipes. In any case the operation is more efficient if performed at the end of a period of banked fires, when the sediment has been allowed to collect in the bottom of the boiler, and especially in the short length of pipe which intervenes between the boiler and the blow-off cock.

Blowing-off for sediment may be stopped at any time when the water runs off in a practically clear condition. The soluble salts are, however, not in any direct way manifested; the solution is quite clear. The presence of soda may however be safely inferred when incrustation is observed at the water gauge fittings, or wherever slight exudation of boiler water is observed. At such times increased blowing down is required. It is possible that practically all the sedimentary matter may be removed by blowing down. The soluble matter is, however, uniformly distributed, and therefore can only be withdrawn in proportion to the quantity of water removed.

The term "soluble salts" is here intended to apply to all salts found dissolved in the boiler water. They may be present on account of the water used containing large quantities of salt and sodium sulphate; or as already explained they may be produced in the treatment of the water, or they may be produced in the boiler by the use of alkaline boiler compositions. A boiler of small water-capacity obviously will become fouled more rapidly than one of larger water-capacity, and therefore requires to be more frequently blown down in order to prevent excessive density.

Caustic or carbonate of soda accumulating in the boiler when exceeding 100 grains per gallon will promote priming and foaming in the boiler, whereby its economical working is prejudicially affected, and also the working of any engine to which the steam may be supplied. When it reaches 500 grains per gallon, the water attacks all ordinary brass fittings with which it comes into contact at boiler temperature.

When the amount of soluble salts reaches 1,750 grains per gallon it is of the strength of ordinary sea water as existing around the British coasts, and its presence and amount may be shown by the salinometer, which should always be used where any possibility of such amounts may exist. Pure sea water of greater strength is regularly used in marine boilers, but in the case of land boilers the accumulated solids are of miscellaneous and uncertain composition for which reason the point of danger is reached much earlier than in marine boilers. The best course is to collect samples of the water as supplied to the boilers, with special attention to the importance of average quality. These should be subjected to analysis, and the blowing-off should be done in strict accordance with the instructions of the chemist.

In a recent case, extensive damage was caused to a boiler, the feed water of which originally contained 21 grains of incrustation matter per gallon, which was reduced to 4 grains in an efficient softening plant. The original water only contained 9 grains of common salt, but a larger amount of soluble substances was produced in the chemical reactions of the process. The water contained in two working boilers was examined, and in one of these it was found that the water contained 1,500 grains of soluble salts per gallon, or about half a ton accumulated in one boiler. Other solids in the water bring the total solids up to 1,736 grains per gallon, or almost precisely the amount of common salt contained in the densest sea water around the British Islands. Unfortunately, such cases are frequently occurring, and at the moment of writing the Vulcan company has been notified of another, in which salt scale has been found in dangerous quantity.

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WATER FAMINE IN MONTREAL.

A SERIOUS break in Montreal's only intake pipe occurred on the afternoon of December 25, which put the low level pumping station out of commission for eight days and resulted in a very serious shortage of water all over the city. The intake is a reinforced concrete horse-shoe shaped underground conduit with a horizontal axis of 9 feet and a vertical height of 7 feet 4 inches. The break, which occurred about a mile from the pumping station, was some 60 feet in length. General opinion as to the cause of the break places the blame on certain excavation work that was being carried on close to the conduit.

Before the conduit was built, about five years ago, the city's water was brought to the pumping station by an open aqueduct. The concrete conduit was commenced in 1908 on the recommendation of Mr. Geo. Janin, the present City Engineer, the object being to avoid contamination of the water. In 1910 work was commenced on the enlargement of the old aqueduct with a view to obtaining a further supply of water for industrial and power purposes. This work had only been completed a short time, when further enlargement was decided upon and is still being carried out by the Cook Construction Co. The aqueduct runs parallel to the conduit and in its enlarged cross-section approaches the latter very closely.

First Sign of Trouble.

About the middle of December the conduit was found to be leaking badly, due apparently to the removal of aqueduct support by the surrounding soil, as a result of the adjacent excavation work. The conduit, at the point where the leakage occurred, was uncovered, and the cracks were caulked. It was then attempted to give proper support to conduit by driving sheet piling and packing in stone filling. This work was completed on December 23, but proved merely a temporary expedient; for as above stated a disastrous break occurred at about 5 p.m., December 25 and the pipe quickly emptied itself.

At the time of the break Montreal's upper level reservoir was only half full, and but for the help of the Montreal Water & Power Company, a corporation which supplies certain of the surrounding districts, the city at the end of a very few hours would have been absolutely without water. The above mentioned company were able to supply about 15,000,000 gallons per day, but the city's normal daily consumption is about 50,000,000 gallons; so that very serious loss and inconvenience were caused, especially in the uptown district. Before the service was restored sanitary condition had become serious and the ever present danger of a huge fire kept the public in an extremely nervous state of mind.

Repairing the Break.

As soon as the break was discovered, a gang of men was collected and the work of repair commenced. A rush order was placed with the John McDougall Caledonian Iron Works Company for seven lengths of steel tube 7 feet in diameter, each length to be 18 feet long with an angle iron jointing ring at each end. The first operation to be performed was the removal of the burst section of the conduit, which was to be replaced by the steel tube. For this work a drag line excavator, which had been working on the adjacent aqueduct and had very possibly caused the original damage, was brought into requisition. The length of conduit removed was 62 feet, so that the seven lengths of pipe, when bolted up, gave a lap at each end of 32 feet. The space between the outside of the pipe and the walls of the conduit was then filled in with bricks dipped in bitumen, concrete being also poured in by means of holes bored through the top of the conduit. Early on the morning of December 31 the pumps were started up once more, but had to be promptly stopped again as the leakage at the steel pipe was found to be very serious. This necessitated the emptying of the conduit again and sealing up of the joint more carefully. The concrete was given 30 hours to set and the timber staging supporting the steel pipe was strengthened. These steps proved effective and by the early morning of January 3 there was once more full pressure all over the city.

Needless to say public opinion was greatly exercised over the calamity, which is unprecedented in the history of Montreal, or probably of any city of like size. Had the break occurred during the summer the results would have been infinitely more serious, and steps are now being taken to prevent a repetition of the water famine by running a steel pipe 1,200 feet long from the pumping station to the Lachine canal. This, of course, will only be used in emergency, as the water so obtained would not be all that could be desired for drinking purposes.

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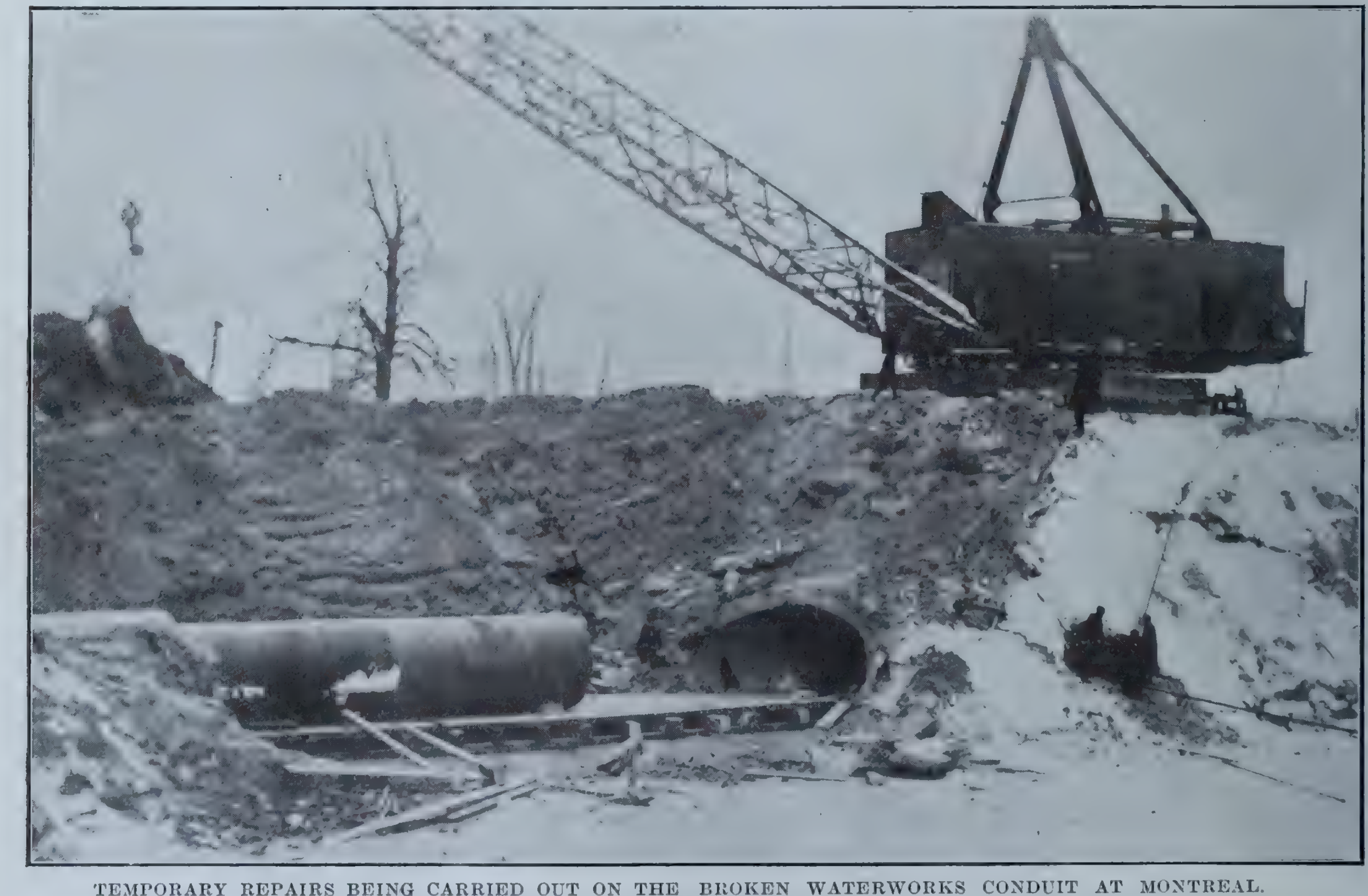
John R. Freeman, who has been engaged as an expert to inquire into the water situation in Montreal, was born in 1855, and received his early training as an engineer with the Essex Company of Lawrence, Mass., of which the late Chas. J. Storrow, one of the earliest and most able of hydraulic engineers in America, was the executive head. After acting as consulting engineer to various manufacturing companies, Mr. Freeman opened an office in Boston.



TEMPORARY REPAIRS BEING CARRIED OUT ON THE BROKEN WATERWORKS CONDUIT AT MONTREAL.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

MECHANICAL DIFFICULTIES IN ELECTRICAL DRIVES.

THE standardization of electrical machinery has now reached such an advanced stage that there is a very great temptation for those who have not thoroughly considered the matter to regard the installation of electric power as simply the question of putting down a plant in the most convenient spot and attaching the motor to it in the quickest and simplest manner.

While this point of view has a good deal to recommend it, it should never be forgotten that unless adequate precautions are taken in connection with the mechanical position of the drive, there is a certain amount of trouble which will develop, more particularly if the installation is subjected to any abnormal conditions of heating or similar causes, and it will, therefore, be worth while mentioning one or two cases where trouble has occurred in connection with the mechanical portion of electrical drives.

It may be said that the instances mentioned are derived from experiences in connection with electrical plant in the tropics, and, therefore, the conditions under which the plant was operated may be somewhat more severe than is usually the case; but even taking this into consideration, the principles underlying the notes are identical with those obtaining in ordinary everyday practice, and are, therefore, of a fairly wide interest.

Extremes of Temperature.

Where temperature conditions are at all extreme it is very frequently found that considerable trouble is experienced in connection with the bearings, and very hot bearings are quite common on generators and motors in tropical climates. Where much care is not taken to avoid overheating, it will be found that the high temperature of the enclosure in which the motors are placed, combined with the development of heat from the windings, causes the oil, even if this be of a heavy nature, to be always in a condition approaching boiling point, and it is not an uncommon experience to find that, after a run of about three days, the bearings, unless they are watched for the purpose, will fire.

This is caused by the fact that owing to the high temperature to which the oil is exposed, the nature is rapidly drawn out of it, and on more than one occasion it has been discovered that firing has taken place in this way, and when the bearing has been opened up, the shaft has been found to be covered with a deposit not unlike a layer of shellac varnish. The same kind of deposit is also found along the edges of the brasses, and, when this kind of deposit appears, the shaft is liable to run very dry and fire almost immediately.

The only way to get over trouble of this nature, providing the best oil obtainable is being used, is to carefully watch the bearing and to carefully time the machine. After, say, about 2½ or 3 days running time, the machine should be shut down, the oil well emptied and thoroughly cleaned out, and the oil changed. If caught in time, no damage is done to the shaft, and providing that at each change of oil the bearing surfaces are well cleaned with paraffin or kerosene, the difficulty alluded to can be satisfactorily overcome. It will be seen that this requires unremitting attention on the part of the motor attendant.

Ball Bearing Remedy.

This is by no means a fictitious trouble, and, as a matter of fact, in tropical climates most generator and motor bearings give a lot of trouble in this way and require so much supervision that it is now found a very useful practice to employ, instead of plain white metal bearings, ball-bearings in order to avoid breakdown. These ball-bearings have been found to be most useful in connection with motors of small and medium sizes, as they will run with graphite lubrication in a very smooth and satisfactory manner for long periods, but they are not quite so good for the bearings of large main generators, inasmuch as the bearing loads for such purposes are so heavy. Thus, in such cases, the best way of modifying the difficulty referred to in the previous paragraphs as far as possible is to instal with the bearings an efficient system of water-cooling, so arranged that a free and ample stream of as cold water as possible can be continuously maintained in intimate contact with the shell surrounding the actual bearing surface. If this is thoroughly well attended to, it will be found that bearing difficulties due to overheating will be largely avoided.

Care of Belt Drives.

Another thing which requires considerable attention where motors drive a plant by means of belts, and not by spur or other rigid systems of gearing, is to see that the belts receive proper treatment. There is very great danger, especially in tropical climates, that if a belt is allowed to run without ample periodical attention, it will become dry and slip.

The average attendant then seeks to overcome the difficulty by tightening up the belt to stop the slipping, and this proceeds until the strains upon the belt and pulleys are altogether in excess of those which should normally occur, bringing about in time inevitable damage. On the other hand, the use of belt dressing to keep the surface of the belt in a pliable and clinging state while extremely useful, should only be adopted in moderation.—The Power User.

* * *

INTERESTING EXPERIMENTS.

EXPERIMENTS have been carried out to ascertain the danger from electric shock in directing a stream of water on a high-tension electric line. The resistance of a stream of water between the nozzle of a hose and a 12 ft. length of No. 6 copper wire was measured. Energy was obtained from a 250,000-volt 50-kilowatt transformer, with the middle point connected by a low-reading ammeter to earth and one terminal connected to the line. Variations of frequency between 45 and 60 cycles with 20,000 volts showed no appreciable reactance of the stream; resistance was calculated from current and voltage readings. The resistance of the stream rose with increase of water pressure, being slight for 6 ft. to 10 ft. lengths of streams, but marked for 15 ft.

With a 1 ⅛ in. nozzle for 5,000 and 30,000 volts, critical lengths of stream were found up to which the resistance had a gradual increase, these being 17 ft. for a 1⅛ in. nozzle, and 20 ft. for a 1½ in. With a stream length of 15 ft. on a 50,000-volt line, a resistance of about 20,000 ohms water path was obtained, giving a current of about 0.25 amp. This would give the holder of the nozzle a severe shock and might be dangerous. With a stream length of 20 ft. for a 1⅛ in. nozzle, or 25 ft. for a 1½ in. nozzle, the resistance was 800,000 ohms. This might be painful but practically not dangerous. The resistance of the body, being relatively low, is neglected.

The fact that a nozzle is earthed through the stream of water in the hose was not found to eliminate danger to the nozzle holder. The resistance of this path from nozzle to earth, through the water in the hose when the latter was thoroughly insulated from earth, was found to be about 150,000 ohms per 100 ft., which could not be depended upon to shunt much of the current from the man holding the nozzle.

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WATER RAISING AND MEASUREMENT.

In a paper read before the Association of Engineers-in-Charge, Mr. W. H. Booth dealt with water-raising and measurement. Water-raising, omitting primitive machines, he stated, is carried out by means of machines which may be classed in six divisions, represented by the scoop wheel, the displacement rotary pump of the gas exhaustion or similar type, the centrifugal pump and the bucket pump, which may be made either with a bucket, a plunger, or both, or with many buckets on a chain run continuously up a pipe; by the air-lift pump, or, as a class alone, the Humphrey gas pump, in which the duties of the pistons of both the pump and the actuating gas engines are filled, and well filled, by the water to be raised.

Needless to say, water-raising is done under so many conditions that considerable judgment must be used in selecting the machine proper to each condition. Under very heavy pressure the bucket of a reciprocating pump takes the form of a ram. The extreme case is the small ram of the pump of an hydraulic press. The more moderate case is the boiler feed pump.

The scoop wheel is a very low breast water wheel reversed, and, as such wheels may be seen in Holland, where they are found in lifts of about 4 ft., they are very efficient machines for lifting much water to a moderate height, and are thus employed to freshen up the Amsterdam canals—that is to say, to remove the stagnant water when the canals are supplied with clean water from the sea or some land drain. The scoop wheel is large and slow of movement, and is thus a very safe machine. It is simply a low breast wheel of which a few degrees of arc of the lower part of the wheel runs a close fit in a circular breast of masonry. The floats are not radial, but so inclined from the radius that the edges somewhat face the stream to be raised and discharge at a convenient angle on the upstream side of the low lift. This is done so that the water in dropping out of the wheel gives a minimum of back pressure.

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MY FUTURE—A CREED.

By H. F. Frasse.

I KNOW that my future depends upon myself, because the manner in which I perform the duties assigned me will determine my value.

I shall always give a heaping measure, that my pay may be in proportion to the service I render.

It shall be my aim to work for, talk for, and boost my employer, because I am one of the organization.

Under no circumstances shall I listen to or take part in discussion affecting hurtfully the welfare of my employer.

I believe that every man will find if he look carefully into his own work that he has an undiscovered character for good; as well as that he possesses loyal service to give his employer.

I know there is no substitute for thorough-going, ardent and sincere earnestness, nor does it come of its own volition. It must be considered and made positive in each man's mind.

I am convinced that one man is better than another according to the quality, more than the quantity, of work he performs.

I shall always be cheerful with my associates and outsiders, because cheerfulness is contagious, lightens the work and brings credit to my concern.

Light hidden under a bushel is seen by no one, hence is of no value in making comparisons.

I shall let my light so shine that all men may see my good work and benefit thereby.—N.E.L.A. Bulletin.

◆

TRANSMISSION MACHINERY CONTRACT.

THE Chapman Double Ball Bearing Co., have recently secured the contract for the complete transmission equipment, including their ball bearing hangers, for the new Michigan Central Railway Shops at St. Thomas, Ont. This Chapman company has previously equipped the Grand Trunk Railway Co. shops at Stratford, the National Transcontinental Railway shops at Transcona, the Canadian Pacific Railway at West Toronto, North Bay, McAdam Junction and a section of the Angus shops, and the Intercolonial Railway shops at Moncton, N.B. and Riviere du Loup, Que.

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RECENT IMPROVEMENTS IN WELDING.

A LECTURE was recently given before the Birmingham Metallurgical Society by Mr. Alex. E. Tucker, F.I.C., on "Recent Improvements in Welding," in which the conditions for successful welding were discussed. Mr. Tucker showed that the thermit process, in which aluminium powder was used, was of great use in the Russian-Japanese war, and had been the means of repairing extensive damage done to the Russian fleet. The replacement of acetylene by hydrogen in the cutting and welding of steel was also discussed. Mr. Tucker pointed out that the difficulties of making successful welds with acetylene in the case of parts of engines and machines was very great. There was always the risk of carbonization on the one hand and oxidation on the other. This was not the case when hydrogen was used, and modern practice showed the reality of these objections.

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ICE TROUBLE OVERCOME.

THE water-wheels of The E. B. Eddy Co., at Hull, Que., are practically the only ones at the Chaudiere not shut down or hampered on account of anchor ice. Mr. Millen of The Eddy Co. appears to have solved the problem of anchor ice, and found the way to prevent it forming on the racks of the intake.

When the Eddy Company decided to more than double their old water powers by putting in new wheels and new systems, and converting the whole into a Hydro-Electric plant, Mr. Millen had the entire fore-bay covered with a concrete platform—put two fans under this platform, and one fan inside, near the clear storey roof of the No. 1 paper mills. These fans exhaust all the steam and hot air from the paper mill, expel it into the vacant space over the water and under the flooring of the fore-bay. This keeps the temperature at the racks just sufficiently warm to prevent ice forming on the racks.

◆

C. C. Cariss, chief draughtsman for the Leonard Engine Works, London, Ont., has been appointed instructor in mechanical drawing and shop mathematics for evening classes, at Ingersoll, Ont.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent practical questions, and give same, direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

Question.—A system of pulley blocks is used to lift a weight of three tons, and if the number of sheaves in the blocks are such that 16 feet of slack is gained for every foot the weight rises, what power will be required if friction be neglected?

Answer.—Three tons is equal to 6,000 pounds; therefore, the pull required will equal $\frac{6000\times1}{16}$ or 375 pounds.

* * *

Question.—A mechanic exerts a pull of fifty pounds at the end of a three-foot spanner, and the nut which he is tightening has a pitch of four threads per inch; if friction be neglected, what stress would he bring to bear on the bolt?

Answer.—Let us suppose a revolution to take place, then the end of the lever in the operator's hand would pass through a space which is the circumference of a circle whose radius is three feet, while the nut would move ¼ inch. The circumference corresponding to 3 feet is 226 inches, therefore, the ratio of motion is 226 to .25 $=\frac{226}{.25}=904$ to 1, and the stress on the bolt being tightened, would equal $50\times904=45{,}200$ pounds.

* * *

Question.—A pressure of 10 pounds acts at one end of a system of levers, and it is found that if motion were to occur, the end where this pressure acts would move through a space 40 times as great as the other end. What pressure would be exerted on the latter?

Answer.—The motions are 40 to 1 and, since the pressures are inversely as the motions, the pressure required would equal $\frac{10\times40}{1}$ or 400 pounds.

* * *

Question.—A balance weight attached to the crank of an engine weighs 4,000 pounds, and the distance where its mass may be supposed to be concentrated is 1½ feet from the centre of the shaft; the revolutions are intended to be 120 per minute, and two is the number of bolts determined upon to secure the balance weight. What should be the size of the bolts if they are of 62,720 pounds tensile strength, and with an assumed factor of safety of 10?

Answer.—The circumference of 1½ feet radius is 9.427 feet; therefore, the circumferential velocity at 120 r.p.m. will be $9.427\times120=1{,}131$ ft. per minute, or 18.85 ft. per second. The centrifugal force or tension on the bolts will be $\frac{4{,}000\times18.85^2}{32\times1.5}$ or 29,527 pounds, which is 14,763 pounds to each bolt. As the tensile strength of the bolt material is 62,720 pounds and the factor of safety 10, therefore $\frac{14{,}763\times10}{62{,}720}=2.35$ square inches area at the bottom of thread, equivalent to 2⅛ in. diameter and 4½ threads per inch. The figure 32 used in the calculation is the acceleration due to gravity in feet per second.

* * *

Question.—Express by means of a formula how the dead load at the pitch circle of a gear wheel to transmit the required power is computed.

Answer.—Multiply the horse-power to be transmitted by 33,000 and divide by the velocity of the pitch circle in feet per minute. Example, if the horse-power to be transmitted is 500, and the pitch circle velocity be 2,000 ft. per minute, then $\frac{500\times33000}{2{,}000}=8{,}250$ pounds, or the maximum load at the pitch circle.

* * *

Question.—A feed pump has to discharge 1,925 pounds of water per minute against a pressure of 90 pounds per sq. inch, and the area through the valves is from restricted discharges, etc., what 2 sq. inches; neglecting friction and loss would be the horse-power required?

Answer.—Since the fluid is water, the head corresponding to 90 pounds pressure equals 90×2.31, or 207.9 feet. The discharge per second will be $\frac{1{,}925}{60}$, or say 32 pounds, and since a cubic inch of water weighs .036 pounds, the discharge will equal $\frac{32}{.036}$ or 900 cubic inches per second. Also, since the area through the valves is 2 sq. inches, the velocity will be $\frac{900}{2}$, equal to 450 inches per second, or 37.5 feet per second, and the head necessary will be $\frac{37.5^2}{64}$ or 22 feet. The total head required equals 22×207.9, say, 230 feet, and the horse-power will be $\frac{1925\times230}{33000}$ or 13.4

* * *

Question.—Steam is expanded to 10 pounds absolute pressure, and it is desired to have the feed water at 130 degrees, the temperature of the injection water being 86 degrees, how many pounds of injection water, per pound of steam condensed, will be required?

Answer.—The total head of steam at 10 pounds absolute is 1172.3 thermal units, therefore the ratio required is $\frac{1172-130}{130-86}$, or 23.7 to 1. The common allowance for engines with surface condensers is 24 to 30 times the weight of steam condensed, and for engines with jet condensers, from one-third to one-half the cylinder capacity.

* * *

Question.—Why do the driving wheels of a locomotive frequently slip at starting, and how does the application of sand overcome the difficulty?

Answer.—If the tractive force exerted by the locomotive exceeds the frictional resistance at the rails due to the adhesion of the driving wheels, then the wheels will slip. The resistance to slipping varies with the condition of the rails, and is greater when they are dry or wet than when they are merely damp. The application of sand to the rail, of course, increases the friction and enables the driving wheels to obtain a grip. To avoid slipping, the tractive force should not exceed about 22 per cent. of the weight on the coupled wheels.

* * *

Question.—A bucket conveyor driven by an electric motor is used for lifting coal from a railroad car to a hopper 50 feet above the car. If 40,000 pounds of coal are raised per hour, find the horse-power of the motor. Assume the combined efficiency of motor and conveyor to be 60 per cent.

Answer.—$\frac{40000\times50}{60}=$ foot-lbs. of work done per minute. Since the efficiency of motor, etc., is only 60 per cent., the horse-power required will be

$$\frac{40000\times50\times100}{60\times33000\times60}=16.83\text{ h.p.}$$

Question.—A safety valve is 3 inches in diameter; the lever is 24 inches long and weighs 15 pounds, its centre of gravity being 13 inches from the fulcrum. The weight of the valve and valve stem is 12 pounds, and the centre line of the valve is 4 inches from the fulcrum. If a weight of 70 pounds is hung on the end of the lever, at what pressure per square inch will the valve commence to blow off?

Answer.—First calculate the area of the valve, thus $.7854\times3\times3=7.068$ sq. in. The forces holding the valve down on its seat are three in number:

(1)—The weight, 70 lbs., multiplied by its 24 inches distance from the fulcrum.

(2)—The weight of the lever, 15 lbs., multiplied by the 13 ins. distance of its centre of gravity from the fulcrum.

(3)—The weight of valve and stem, 12 lbs., multiplied by their distance, 4 ins., from the fulcrum.

The above three moments act downwards, and their sum must be equal to the upward moment due to the total pressure on the valve, multiplied by its distance, 4 ins., from the fulcrum.

Call the boiler pressure P pounds per square inch. Then

$$P\times7.068\times4=(70\times24)+(15\times13)+(12\times4)=P\times28.272=1680\times195\times48=1923$$

$$P=\frac{1923}{28.272}=68 \text{ pounds.}$$

* * *

Question.—To what strain is the shell of a steam boiler subject?

Answer.—To a tensile or tearing apart strain in the girth direction of the plate. For this reason we use the ultimate tensile strength of the material, in calculating the working pressure permissible.

* * *

Question.—If you were specifying the steel for boiler shell plates, what qualification would you make in respect to thickness and quality?

Answer.—That each be uniform, providing equal wear and strength throughout.

* * *

Question.—Is the shell of a boiler equally strong longitudinally and circumferentially?

Answer.—No, it is twice as strong in the latter direction as it is in the former.

* * *

Question.—In a new, well-designed, well-constructed boiler, where is the shell weakest?

Answer.—Along the riveted joint, due to the rivet holes.

* * *

Question.—Why is a butt joint preferable to a lap joint in a steam boiler?

Answer.—Because it avoids offsetting the plate ends, keeps the shell in a true circle, and gives a stronger joint.

* * *

Question.—What is the objection to welding the longitudinal joints of a boiler shell?

Answer.—No guarantee can be had of the reliability of a weld. The pressure being internal and bursting, would tend to aggravate any imperfection, and open the weld, causing an explosion.

* * *

Question.—What is the difference between a tube and a pipe?

Answer.—A tube is indicative of surface, a pipe of area. Example—A 3-inch tube will measure 3-inch outside diameter, while a 3-inch pipe will measure 3-inch inside diameter.

* * *

Question.—Are two 4-inch pipes equal in area to one 8-inch pipe?

Answer.—No. The 8-inch has an area double that of two 4-inch pipes. Doubling the diameter, therefore, increases the area fourfold.

WEDGES, SCREWS AND SCREW JACKS.

By H. Womersley.

THE wedge is a double inclined plane, hence when two bodies are forced asunder by its means in a direction parallel to its head, by multiplying the resistance by half the thickness of the head or wedge back, and dividing the product by the length of one of the inclined sides; the quotient is the force equal to the resistance.

Example.—The breadth of the back or head of the wedge being 3 in., and its inclined sides 10 in., required the power necessary to act upon the wedge to separate the substances whose resisting force is 150 lbs.

$$\frac{150\times1.5}{10}=22.5 \text{ lbs.}$$

When only one of the bodies is moveable, the whole breadth of the wedge is taken as the multiplier, and the following rules are for such wedges acting under pressure on the head of the wedge only.

To find the tranverse resistance to the wedge or weight; multiply the power by the length of wedge, and divide by the breadth of the head.

To find the power: multiply the weight or tranverse resistance by the breadth of the head, and divide by the length of the wedge.

To find the length of wedge; multiply the weight by the breadth of the wedge, and divide by the power.

To find breadth of wedge: multiply the power by the length of the wedge and divide by the weight.

The Screw.

The screw in principle is that of an inclined plane wound around a cylinder which generates a spiral of uniform inclination; each revolution producing a rise equal to the pitch of screw. The pitch being the height or angle of inclination, and the circumference the length of plane, when a lever is not applied; but a lever being a necessary qualification of the screw, the circle which it describes is taken, instead of the screw circumference as the length of the plane; hence the mechanical advantage—as the circumference of the circle described by the lever where the power is applied is to the pitch of the screw, so is the force to the resistance.

Example I.—Required the effective power obtained by a screw ⅞ in. pitch, and moved by a force equal to 50 lbs. at the extremity of a lever 30 in. long.

$$\frac{30\times2\times3.1416\times50}{.875}=10760 \text{ lbs.}$$

Example II.—Required the power necessary to overcome a resistance equal to 7,000 lbs. by a screw 1¼ in. pitch and moved by a lever 25 in. long.

$$\frac{7000\times1.25}{25\times2\times3.1416}=55.73 \text{ lbs.}$$

The Screw Jack.

To find the weight a screw jack is capable of lifting, the screw being ½-in. pitch, radius of handle 30 in. and force applied 40 lbs.:

$$\frac{40\times30\times2\times3.1416}{.5}=15{,}080 \text{ lbs.}$$

FAMILIARITY BREEDS CONTEMPT.

AN inspector going through a plant in Illinois observed a set-screw projecting on a revolving shaft. He considered it particularly dangerous because the shaft was near a passageway and workmen were continually going back and forth past it. He called the manager's attention to it. "Don't you think," he said, "that that set-screw had better be cut off? Someone will get hurt some day if it is left that way." "I don't think so," the manager replied, "that set-screw has been like that for years. No one has ever been hurt by it. The fact that it is exposed and can be observed by anyone renders it safe from causing an accident." This manager had a habit of gesticulating when speaking, and, as he waved his arm to emphasize what he was saying, the sleeve of his coat came in contact with the set-screw and caught on it, and in an instant he was whirled to death.

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

COMPETENCY OF STATIONARY ENGINEERS.

By Harry Dickinson.

IN the December issue of The Power House W. Hoxtable has an article entitled "Letting in the Light." Mr. Hoxtable speaks of what he has seen some stationary engineers do. One put eight pails of water in the boiler, closed it up, and then finished pumping with injector. Now, Mr. Editor, does that look reasonable? What size was this boiler? He did not say. He also speaks of boiler inspectors being appointed with only two years' experience. Let me say that it takes a man with hard brains to fill a soft position, and if the inspector was not capable, he would not be appointed.

Mr. Hoxtable also speaks of the graded certificate. I can see nothing wrong with the one which the Government now gives out. Graded certificates will not keep the boiler clean. Let the boiler inspector or the factory inspector have a little to say about the certificates. You will find lots who call themselves first-class men who could do more on paper than they could on actual plant operation.

* * *

REORGANIZING THE BELTING DEPARTMENT. OF A MACHINE SHOP.

By H. Womersley.

ABOUT three years ago I took charge of a machine shop and was told that any improvements I wished to introduce would be welcomed. I can assure you there was plenty of scope. The belting was in a deplorable condition, so I decided to tackle it first, and what follows is an outline of how I proceeded to bring this important equipment to a proper state of efficiency.

I entrusted the care of all belts to one man and held him responsible for all repairs, alterations and dressings. Notices regarding this were posted throughout the shop. The belt man was supplied with the necessary tools, which consisted of clamps and rods, belt scraper, knife sharpener, awl, drive punch, blind punch, staple puller, pegging hammer, brush for compound, etc.; also a compound for preserving leather belts made from the following:—Two quarts castor oil, 1 lb. tallow, 1 oz. powdered resin, 2 oz. hard soap, melted and mixed together.

I next instructed him as to how I wanted the belts repaired and cleaned, and informed him that he must make a careful inspection of all belts at frequent intervals and keep a record of same. His inspection must cover such points as general condition, whether overdry, or saturated with oil; whether any laps had begun to start open, or whether a belt needed early replacement.

If the belt were dry or harsh he was to first clean off the surface dirt, this being accomplished by means of a cloth, damped in kerosene, if need be. In bad cases, the belt was to be scraped; the ideal aimed at being a clean leather surface. A light application of dressing was to follow. For greasy belts, wiping on the pulleys with a dry cloth or some absorbent material would help, but, if possible to remove the belt, packing in dry sawdust or shavings was recommended for the purpose of absorbing the oil. An excess of oil, it should be explained, tends to rot the leather.

Jointing Belts.

I next instructed him on jointing belts, and as I have a fancy for the "hinge" style, I showed him how to make that joint as follows:

Cut the ends of belt to be joined perfectly true with a tee square.

Punch two rows of holes in each end of the belt, care being taken that the holes are not opposite each other, and that one of the ends contains one more hole than the other.

No hole should be less than ½ in. from the edge of the belt, and no nearer than ¼ in. to the end. The second row must be 1 in. from the end alternate with the first row. A good rule is as follows:—

2 in. to 2½ in.	3	holes.
3 in. to 4 in.	5	"
5 in.	7	"
6 in.	9	"
8 in.	13	"
10 in.	15	"
12 in.	17	"

Width of Belt Lacing.

Up to 5 in.—¼ in. and 5-16 in.
6 in. to 14 in.—⅜ in. and ½ in.
14 in. and over.—⅝ in.

Begin to lace by drawing half the lace through the centre hole. If you commence with the upper end of lace, pass it over the one, and under the other end of belt, and continue in this way, over and under until the last hole is reached; then fasten your lace in the usual manner. When you commence to lace with the lower half of lace, follow same method, except that you pass the lace under the one and over the other end down through the hole from the opposite side of belt. Both sides of belt show lacing to be alike. This plan of lacing produces pliable joints.

Next avoid putting on belts too tight. The proper tension is of fundamental importance. If too tight, there is a large unnecessary loss of power from excessive friction. On the other hand, if too slack, the belt is liable to flop around and jump off the pulleys when a load is suddenly thrown on and off.

I also pointed out to him that single belts should be put on to run with the grain or hair side, next to the pulleys, and so that the joints of the laps run against the pulleys, as the laps on the outside of a belt are most liable to come apart when the joints are run against the atmospheric pressure. Double belts should be put on so that the points of the laps run with the pulleys, as both sides point in the same direction.

Belting Rules.

I wrote him out the following rules regarding belting:—

To find the Velocity of Belting—Multiply the diameter of the pulley in feet by 3.1416, and again by the revolutions of the pulley.

To Find the H.P. of Belting—Multiply the velocity by the width of the belt in inches, and that product by 50 for single, 80 for double, and by 100 for three ply. Divide this product by 33,000 and the quotient will be the H.P. which a good belt can safely transmit.

To Find the Width of Belting—Multiply the given H.P. by 33,000, and divide this product by the product of the velocity multiplied by 50 for single, 80 for double, and 100 for three ply.

To find the length of belts when it is inconvenient to use a tape:

(a)—When both pulleys are of about the same size. Add the diameter of the two pulleys together; multiply this result by 3.1416, and divide by 2. To this quotient add twice the distance between centres of the shafts, and this will give the required length.

(b)—When one pulley is considerably larger than the others. Square the distance between the centres of the shaft; add to this the square of the difference between the radii of the two pulleys, and from this total extract the square root and multiply by 2, thus acquiring the total (M). Add the diameters of the two pulleys together and multiply this total by 3.1416, then add to one-half of this result the total (M), and you get length required.

(c)—For cross belts.—Square the diameter of the large pulley and the distance between centres, add together and extract square root. Square the diameter of the small pulley and the distance between centres; add together and extract square root. To the sum of the two roots, add one-half the circumference of the two pulleys, when the total will be the required length.

I must confess here that this beltman turned out to be a very good man, for after this system had been in operation two years, the principal of the firm made this statement to me:

Your system of belt repair is a great success, because it minimizes machine stoppages, the leather bill is going down, less repairs seem to be necessary to shafting, also, the appearance of belts repaired in a uniform manner is not an eyesore as formerly.

◆

SETTING OF VALVES.

By "Staveley."

SIMPLE eccentric.—Set the crank on one of the dead centres, turn the tumbler of the eccentric round to get the required lead, and, having clamped the tumbler, pull the engine over to the other dead centre. If you get the same amount of lead, the tumbler is properly set on the shaft, but if the lead be greater at one end than the other, either the valve rod or the eccentric rod is too long or too short. It is very important to see that the rods are of the right length before attempting to set the valve correctly.

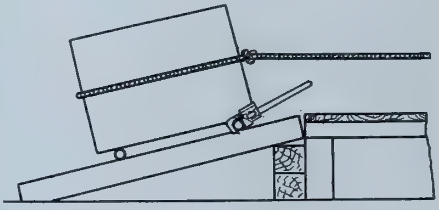
Link Motion.—Set the tumbler roughly in the right position on the shaft, put the reversing lever into full gear, back or front, and see what clearance you have at the top or bottom of die, when the engine is pulled round. Alter the length of the reversing rod to make the clearance equal at the top and bottom, then, keeping the reversing lever in full forward or backward gear, pull the engine round in order to see if the port opening is equal at both ends. If it be not equal, then the eccentric rod or the valve rod is too long or too short. Pull the reversing lever over to full gear in the opposite direction and try again if the port openings are equal. If on both occasions it is found that both rods are either too long or too short, then the valve rod requires altering, but if in one gear the rods are found to be too long, and in the other gear they are found to be too short, then one eccentric rod must be shortened and the other lengthened.

◆

MOVING HEAVY OBJECTS.

By D. S. Mann.

IN moving heavy materials, such as machinery, marble, etc., where rollers are used on wooden timbers, the rollers are found to sink into the wood slightly and often sufficiently to practically prevent the movement. Where a block and tackle is used for pulling, it will often be found that the object will slide on the rollers before they will turn. In such cases it will greatly expedite matters if a pipe wrench is put on each end of the roller and used to propel the same. The results will be surprising and two men with ordinary pipe wrenches can walk a tremendous load up a good incline without any trouble. Of course, some means should be provided to hold the load. The rollers having such a short radius, the leverage gained is great and the action is the same as that of a self-propelled vehicle.



MOVING HEAVY OBJECTS.

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Winnipeg, Man.—The National Construction Co. have applied for a permit to erect a power house for the Provincial Government to supply power to the Parliament Buildings, Law Courts, etc. It will cost $160,000. The boiler room will contain fourteen boilers. There will also be an engine room, workroom, fan room, and pump room. A smoke consumer will be installed.

LOCATING LOSSES IN BELT TRANSMISSION.

By C. T. R.

THE factory superintendent who knows his business is constantly seeking new ways of overcoming loss of power in belt drives. Every belt in a factory drops some power which has been paid for but never received at the final point of application. This loss may run from a nominal amount up to fully half of the actual power delivered at the drive pulley. Efficient production demands that this loss be reduced to a minimum. How to do it is an important study.

Given pulleys of the correct diameter and width, and the proper speed for the machine in question, the greatest loss occurs through slipping or binding of the belt. Dry, hard belts running over slippery pulleys either waste a vast amount of power through slipping, or they have to be drawn so tight that they waste a correspondingly great amount of power through friction. Belts should be run loose and they should be kept in such a natural soft condition that they grip the pulley surfaces firmly without the use of sticky belt dressing.

There is another point where a great loss of efficiency occurs and this is at the joint or lacing, for unless the joint be smooth and flexible, it requires considerable extra power to drive it over the pulleys. A stiff joint works like a street car with a flat wheel, and a joint with an offset or bump on the pulley side may be compared to a wagon wheel passing over a stone on a smooth pavement. Both produce a jerk and both use up unnecessary power.

It has long been known that belts laced with leather lacing are open to the latter criticism, and, furthermore, leather lacings break oftener and take much longer to do than the modern steel lacings. A good steel lacing is superior to leather lacing in durability and saving of time, but the character of the steel lacing should be carefully investigated before a choice is made. The metal lacing must be strong and it must be as flexible as the belt itself. It It should be quick and simple in application, proof against rust and corrosion, and the points of the metal which enter the end of the belt should be so made that they divide the strain evenly and do not cut off any of the belt fibres, for this weakens the belt.

Some metal belt lacings have been very severely condemned by safety authorities because the prongs work loose and catch the clothing or hands of the machine operators, yet this cannot occur where these prongs point back toward the end of the belt and are sunk in flush with the surface.

TENSION ON CYLINDER COVER STUDS.

By J. H. Rodgers.

IN the September, 1909, issue of The Power House a question of steam pressure was brought before the readers, and, after having been discussed for three or four months, the matter was shelved. With a view to reopening the discussion, I beg to submit the following:

The Original Query.

The question as originally stated by Mr. Jones was as follows:—If we had a cylinder cover secured to the cylinder by ten studs, each screwed up to a tension of 1,000 lbs., and if the face of the cover has an area of 100 square inches in contact with the steam, would there be an increased tension on the studs if steam were admitted into the cylinder at 80 lbs. per sq. in.? Mr. Jones thinks there would be no increased tension until the pressure in the cylinder exceeded 100 lbs. per sq. in., and, while I do not agree with him or other readers with a similar theory, I am open to conviction. We are all readers of The Power House to learn and benefit by the articles which appear therein.

Mr. Orr, in the December, 1909, issue, believed that the tension on the studs does increase. He brought before us another question, an offspring of the original, which I believe has not yet been discussed through these pages: "Does the pressure of the steam against the inside of a cylinder cover lessen the screwing-up pressure with which the studs hold the cover against the cylinder end?"

The Writer's Theory.

The accompanying sketch will, I hope, bring to the readers my theory of the above two questions, and for convenience of illustration, only two studs are dealt with, the ultimate total result being obtained by multiplication. In the figures a cover and section of cylinder are shown. Fig. 3 has the stud nuts (n) screwed up against the cover by hand, leaving no tension on the stud except the weight of the cover, which in this instance need not be considered.

If a weight or pressure of 1,000 lbs. per stud, or 2,000 lbs. for two studs, acts on the inside face of the cover, the portion (a) of the stud is under a tension of 1,000 lbs., but the portion (b) is under no tension. Now, remove the 2,000 lbs. weight or pressure and tighten the nuts (n), so that there is a tension of 1,000 lbs. on each stud between the nut and the cylinder end; then hang a weight of 1,000 lbs. on each stud, as shown in Fig. 2. Previous to the weight being applied, there was no tension at (b), but now there is 1,000 lbs. at both (a) and (b), which leaves the nut (n) free to move, also the cover.

Again, if the weights are removed from the eyes of the studs and placed on the cover, as in Fig. 1, there should be 4,000 lbs. tension on the two studs at (a), that is, 1,000 lbs. due to the pressure of each nut and 2,000 lbs. on the cover. This is more clearly shown in Fig. 4, for, while the tension on each stud at (b) is only 1,000 lbs., at (a) the tension is 1,000+half the weight on the cover, or 2,000 lbs. If the weight on the

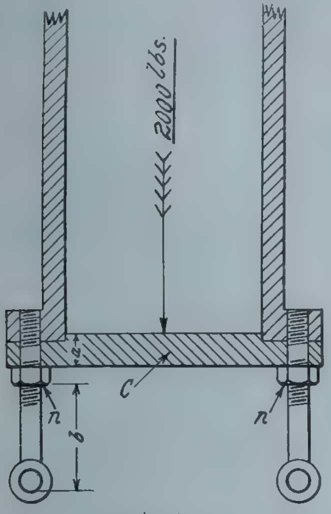


Fig. 1.

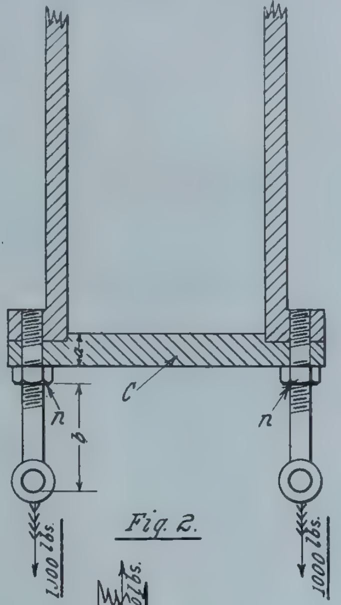


Fig. 2.

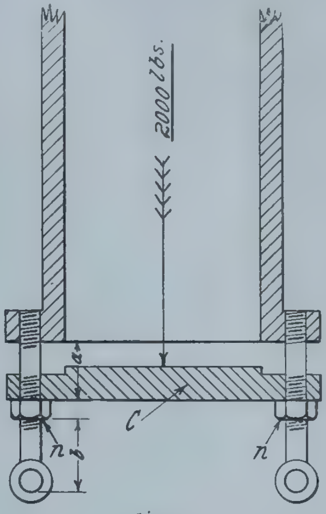


Fig. 3.

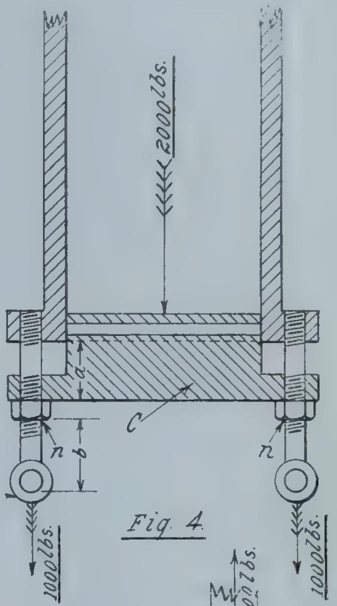


Fig. 4.

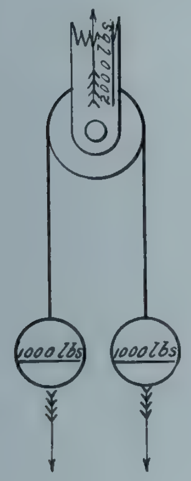


Fig. 5.

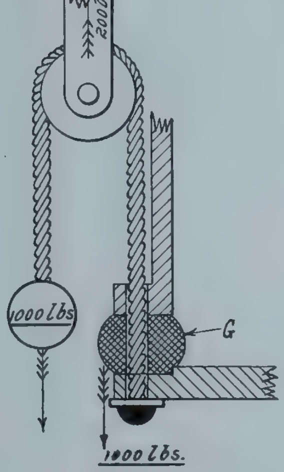


Fig. 6.

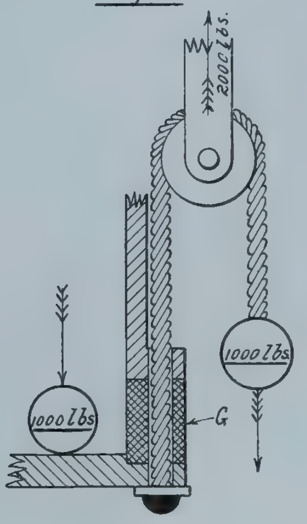


Fig. 7.

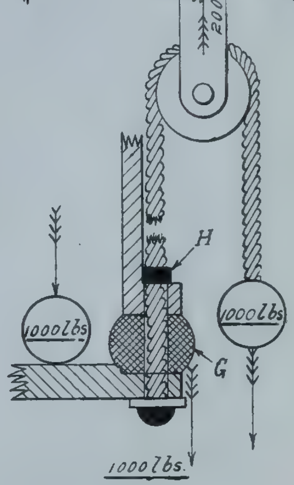


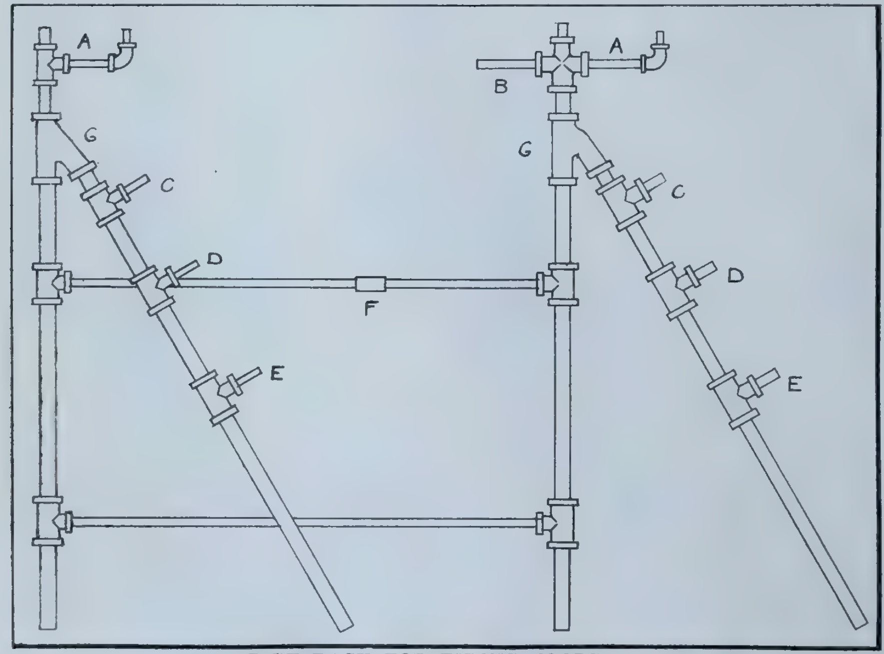
Fig. 8.

TENSION ON CYLINDER COVER STUDS—DIAGRAMMATIC REPRESENTATION.

cover were only 10 lbs., the portion (a) of each stud would have a tension of 1,000+half the weight on cover, or 1,005 lbs. In the above four illustrations the compression of the gasket and flanges are ont considered. Fig. 5 shows a simple pulley supporting two weights, so that while the pulley, bracket and pin are supporting 2,000 lbs., the rope is only under a tension of 1,000 lbs.

In Fig. 6, one of the weights is removed and the rope secured to a washer below the cylinder cover, the gasket (G), enlarged to show the action of compression and extension, being placed between the cover and the cylinder end. The gasket under compression exerts a pressure tending to force the cover away from the cylinder, but is prevented by the tension in the rope or bolt. Now, if a weight equal to the tension in the rope be placed upon the cover, as in Fig. 7, the pressure of the gasket due to compression would force the cover away from the cylinder until the gasket (G) was free, but the rope retains a tension of 1,000 lbs.

Suppose we only place a weight or pressure of 100 lbs. on the cover, the compression of the gasket will be reduced one-tenth, and the pressure due to compression will only be 900 lbs. If the rope, as in Fig. 8, be secured as at (H), while the gasket is in compression, and the rope cut, or replaced by a bolt, the gasket would still exert a force of 1,000 lbs. Now, place the weight or pressure on the cover, and the tension on the rope or bolt will be 2,000 lbs. If a weight of only 15 lbs. be placed on the cover, the tension will be 1,015 lbs. This is what I understand from Newton's Third Law of Motion:—"To every action there is always opposed an equal and contrary reaction."



PIPE RACK FOR FIRING TOOLS.

If the tension of the bolt exerts a force to keep the cover against the cylinder, then the compression of the cover, gasket and cylinder end exert a like force to separate the head and the nut of the bolt, or the nut and opposite end of the stud; therefore, any additional pressure on the cover from the inside must be counteracted by an equal force, and if the studs do not take this extra pressure, what does?

I am not positive that the foregoing reasoning is correct, and I hope that some readers will kindly describe and illustrate their theories, and have them published for the benefit of engineers at large, as the question seems to be of considerable interest to a wide circle of readers.

* * *

PIPE RACK FOR FIRING TOOLS.

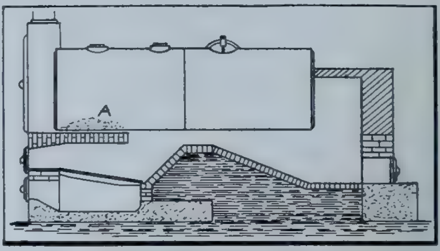
By J. E. N.

THERE have been some curious and wonderful arrangements made and used from old pipe fittings and scrap pipe. Here is another one, and which I am told is new. It is made from one inch pipe screwed tightly into the fittings shown, and is used to hold the rake, hoe and other firing tools on the spikes (C) (D) and (E). If the fireman is the lucky owner of an extra slice bar or other tool, he can place it ready for business in case one of his regular kit gets broken, on the arms shown at (A), and if he has an extra shovel he can hang it on bar (B). The coupling at (F) is right and left hand. If required the half Y fittings (G) can be replaced with full Y's, in which case the rack would probably be harder to upset, but it would occupy much more space then if built as shown.

PROTECTIVE ARCH.

By C. Fenwick.

THE accompanying drawing shows an improved setting for return tubular boilers. The arch over the fire serves the double purpose of improving combustion and preventing the burning of the boiler. In nearly every case, mud and loose scale will lodge as shown at (A) in the drawing, and where very dirty water is used the arch will be a great help.



PROTECTIVE ARCH.

* * *

CONCERNING BELT SPEEDS.

By W. E. Mason.

I WISH to secure such information as will allow me to solve some belt speed problems. We had a chain drive enclosed in a case and the chain ran in oil. The pulley diameters were 15 in. and 4½ in. respectively, but we could not get the speed required, namely 2,000 r.p.m.

The chain drive made more noise than anyone could believe, and after three weeks running, the chain snapped and the case was damaged beyond repair, one of the parts of the chain embedding itself 1½ inches in a brick wall, 30 ft. from the pulleys. We did away with the chain drive after that experience and installed belting with larger pulleys. The engine room is comparatively quiet now, although there is still room for improvement. I want to know the speed of the belt in feet per minute, and to get the rule for ascertaining belt speeds. Do you think the speed is too fast? If so, what will be the remedy. The belt is double cut square, laced, and 8 in. wide.

To intelligently answer the foregoing, the diameter of the belt pulleys should be given.—Ed.

* * *

Lining-up Single Cylinder Slide Valve Engine.—F. H., Montreal, writes.—As I am a subscriber to The Power House may I take the liberty to ask a question? Will you please tell me a short and effective method to line up a single cylinder slide valve engine, also, how to line up, with the crank shaft and flywheel in position.

ASSOCIATION AND PERSONAL

A Monthly Record of Current Association News and of Individuals Who Have Been More or Less Prominent in the Power Field.

LUNKENHEIMER CO. ANNUAL DANCE.

On Saturday evening, December 13th, possibly the largest attended dance ever given in Cincinnati took place at the Armory in that city. The event was the annual dance and entertainment given by the Lunkenheimer Company to its employees and their families, at which it is estimated about 5,000 were present. The Lunkenheimer Company is well known universally as large manufacturers of high grade engineering specialties their executive offices and factories being located in Cincinnati, Ohio, with branches in New York, Chicago, Boston and London.

The company prides itself upon the high quality of its products, but as the officers will explain, this high quality is due to a great extent to a like quality of the men employed and the harmony that exists among them. One of the principal objects of these annual entertainments is to aid in maintaining this harmony, and by bringing the employes together in a social way, meeting each other in a different light from that of business, a feeling of good friendship is created, such as could not be accomplished in any other manner. Again, the size of the Lunkenheimer plant is of such large proportions that the workmen of one department do not have an opportunity of often meeting those of another, but by congregating them in a manner which it has been the practice of the Company to do for many years past, they learn to know each other, so that when they do meet in the factory or any other place, they meet as friends and not as strangers.

The Armory at which the entertainment was given is the largest hall for purposes of this kind in Cincinnati. It was beautifully decorated with holly, and red, white and blue displays. A temporary stand was erected in the centre of the hall for the First Regiment Band, which furnished the music for the dancers, the band consisting of forty pieces and picked musicians. The lower floor of the building was fitted up as a rathskeller, where all kinds of refreshments were served gratis, and where a large orchestra was in attendance. On entering the building, the men were given a case of cigars, and the ladies and children were presented with souvenirs.

During the week of December 8th, all of the travelling salesmen representing the company assembled for a general conference, and they in a body also attended the affair. The look of general satisfaction depicted on the faces of all, when leaving, clearly showed that the efforts of the company for the welfare and happiness of the employes were highly appreciated.

BRITISH COLUMBIA ASSOCIATION OF STATIONARY ENGINEERS.

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* * *

MANITOBA ASSOCIATION OF STATIONARY ENGINEERS.

The Manitoba Association of Stationary Engineers is different from the other Associations throughout the Dominion, having been incorporated for the purpose of issuing certificates to steam engineers who wish to operate in the Province of Manitoba. The grades of certificates issued are first, second and third class. The third class allows the holder to take charge of and operate any steam plant up to 50 h.p., the second class up to 200 h.p., and the first class up to any h.p. These certificates are secured through examinations, which are held every three months in Winnipeg. A meeting of the members of the Association is held each year for the election of a Board of Directors. This consists of five engineers, who meet from time to time to pass upon applications and transact business. A permanent secretary looks after the clerical work, and takes up cases of parties operating without certificates in the Province.

The directors elected for the present year are F. R. Bonner, Ernest Prentice, Thos. Watson, James Reid, and E. Mehmel. F. R. Bonner is President of the Board. The secretary is H. R. Scrimes, 499 Main Street, Winnipeg, to whom all communications should be sent.

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The Board of Examiners is appointed by the Lieutenant-Governor in Council, the appointment being for one year. The present examiners, who have been in office ever since the Act was put in force, are W. R. Cahoon and R. J. Buchanan.

BRITISH COLUMBIA ASSOCIATION OF STATIONARY ENGINEERS.

VANCOUVER Lodge No. 1, British Columbia Association of Stationary Engineers, held its first annual dinner in the Granville Palace Hotel, Vancouver, on New Year's Eve, December 31, 1913. Some seventy-five guests, among whom were a fair sprinkling of ladies, partook of the excellent repast provided by "Mine Host"—Rollins Bros. A feature of the evening, and one which contributed largely to the general success of the function, was the absence of long speeches, the place of the latter being taken by songs, recitations, etc. Only four toasts were proposed and honored, these consisting of "Our King," "Canada," "The President of the United States," and "The Ladies." Mr. John Stone performed the duties of toastmaster with much acceptation.

GRAND LODGE CONVENTION, NORTH-WEST ASSOCIATION STATIONARY ENGINEERS.

THE Annual Convention of the Grand Lodge, North-West Association of Stationary Engineers, opened in the Frank Hotel, Frank, Alta., on Monday, December 29, 1913. The Grand Lodge opened at 10 a.m., with Grand Chief Stewart, of Edmonton, in charge, and Grand Secretary W. G. Singer, of Edmonton, and delegates from the different local lodges in attendance. The Grand Chief gave a very able address, covering the past year's work, and expressed pleasure at the condition in which he found the newly-organized Frank lodge. After laying out the programme of proceedings, the meeting adjourned at 1 p.m. for lunch, following which the Grand Officers and Delegates visited the different plants west of Frank at Blairmore, Coleman and McGillivray, and were shown around by the officials in charge. A night session was held at eight o'clock, and much important business was transacted.

On Tuesday, December 30, the delegates visited plants east of Frank, and met with similar courtesy from the officials at Belle Vue, Hillcrest, Maple Leaf, Passbuy, and Burmis as was accorded them on their visit to plants westward. The Convention was called to order at 3 p.m., and adjourned at 6.40 p.m. A mass meeting was held at 8 p.m., at which questions of interest to the Association were thoroughly discussed. A paper was read by Jas. Donelly, erecting engineer of the Hudson Bay Co. at Edmonton, on steam turbines, their design and operation.

On Wednesday, December 31, the Convention was called to order at 10 a.m., when all business was completed, and officers for the ensuing year elected as follows:—Grand Chief, J. D. Stewart, of Edmonton, re-elected; Grand Vice-Chief, S. D. Shearer, of Blairmore; Grand Sec.-Treas., W. G. Singer, Edmonton; Grand Organizers, W. Simpson, Frank; Jos. B. Verdon, Edmonton; Grand Door Guard, C. Sherratt, Coleman. The Grand Chief upon his re-election was presented with a handsome memento by the delegates. The Convention closed at 6 p.m., December 31, 1913.

On New Year's Eve a banquet was held in the Frank Hotel, and served as a fitting climax to the Convention. At 9.30 some fifty guests partook of a sumptuous repast, served in excellent manner, and made more pleasing by the tasteful and seasonable decorations. The taking of a flashlight picture of those assembled was an acceptable feature at this juncture, following which a lengthy programme was proceeded with. Rev. W. T. Young acted as toastmaster. The opening number was a violin selection by C. and P. Slopak, two Bohemian boys, only a few months out from the Old Land. Their efforts were such as to merit repeated encore demands.

The toast of the Grand Lodge was replied to by Grand Chief Stewart, who remarked that, while all previous Conventions had been held in cities, Frank had the honor of the largest and best gathering in the history of the Provincial organization. He spoke on the object of the lodge as being mainly educational on behalf of its members. They did not believe in the attitude of many to-day, who said to their employers, "You must give us higher wages," but rather by a spirit of co-operation and better equipped men to merit the higher wages. A piano solo by Mrs. W. T. Young followed this toast.

J. Delaney, of Belle Vue, replied to the toast of the Frank Lodge. He spoke of the youth of the lodge, also what it stood for, as well as what it meant to its members, and illustrated the need of unity among men by a story of how the guards of an asylum are never afraid of more than one man at a time, because lunatics never combine. After a well-rendered recitation by H. Ryan, entitled "The Road to Heaven," the toast to Edmonton Lodge was done full justice to by W. G. Singer. The next item on the programme was the toast to the Frank Hotel. W. Simpson replied to the toast, and, in doing so, referred to the geniality of the proprietor, W. A. Manuel, to his kindness to the lodge, and, in spite of the many ups and downs which the town had experienced, to his having stuck to it faithfully.

John Delaney recited "The Cremation of Sam McGee," after which J. Scott, of Coleman, replied to the toast of the "Master Mechanics" in one of the most practical speeches of the evening. He congratulated the lodge on its aims, and assured them that as long as it helped its members to be better men it would be a success. To be a successful engineer it was necessary to be a sober, well-controlled men, these being as important from an educational standpoint as writing examinations. A violin selection from the Slopak boys and a recitation from H. Ryan, entitled, "Trouble in Amen Corner," followed. The toast of the ladies was responded to by the chairman, and, needless to say, full justice was done.

The meeting closed by the singing of "God Save the King," after which the company dispersed.

READERS' QUERIES.

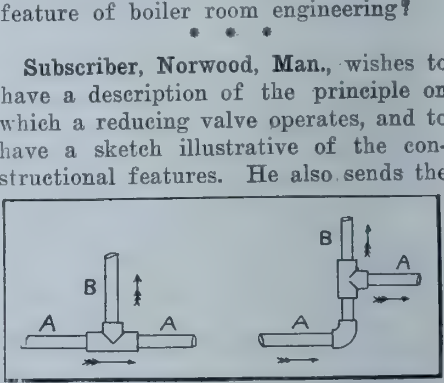
Feeding Boiler Compound.—D. H. P., Winnipeg, Man., writes as follows:—At the plant of wihch I have charge, we are going to instal a Detroit trap, and the question arises how can I get my boiler compound into the trap without using a feed pump? This latter I am going to cut out altogether, except as a standby. The compound I use contains too much sediment, so that I could not very well use a lubricator.

* * *

Replacing Gauge Glasses.—One of our subscribers in Guelph, Ont., has experienced trouble through gauge glasses breaking within a few hours of their replacement after removal and cleaning. He says no such trouble arises when putting in new glasses, and believes, therefore, that an explanation of the breakage on replacement is possible, which, if put to practical use would eliminate the latter. Will some of our readers give their experiences in this feature of boiler room engineering?

* * *

Subscriber, Norwood, Man., wishes to have a description of the principle on which a reducing valve operates, and to have a sketch illustrative of the constructional features. He also sends the accompanying sketch, illustrative of a steam pipe line (A.A.) with branch pipe (B), and would like to have an expression of opinion as to which is the correct arrangement.



STEAM PIPE LINE QUERY.

The MacLean Publishing Company
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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the operation of Refrigerating Machinery.

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TEACHING AUTOGENOUS WELDING.

AUTOGENOUS welding, which only a few years ago was looked upon as a novelty of somewhat doubtful value, has now become an almost indispensable adjunct to many industries . The oxy-acetylene and oxy-hydrogen torch, both for welding and cutting, is now recognized as a very great labor-saving device, and is becoming widely used in the metal-working trades, not only for repair work, but also for manufacturing purposes.

In autogenous welding, it is universally admitted that the reliability of the results attained are very largely dependent on the skill of the operator, and this will probably always be the case. In small plants, where the process is only occasionally employed to effect repairs to some badly needed forging or casting, it has been usual to call in an expert employed by some firm making a specialty of this class of work, and even in our large railway shops, where the process may be in practically continuous use, it is not uncommon to find only one or two men, among the many hundreds employed, who know anything about it.

This has perhaps been unavoidable hitherto, as most of the operators have picked up their welding knowledge in the shop where they were employed, and while these have for the most part become experts, when they leave the shop or are promoted to some higher position, it is hard to replace them, an inexperienced man having usually to be broken in "ab initio" to fill the vacancy. It is, therefore, interesting to note that the Montreal Technical School, recognizing the local demand for skilled welders, are conducting a weekly evening class in autogenous welding at which practical and theoretical instruction in the art is being given by experts. Each lesson lasts two hours, and there are ten lessons in the course.

While it is not suggested that a student can become an expert welder after only twenty hours' instruction, much can be done in that time to impart a good grounding in the subject, and to stimulate a desire for further knowledge of the work. Several men who are employed at this work during the day are attending the class, which is an extremely encouraging sign, for it were safe to say that the majority of operators are not familiar with the theoretical side of the subject, though they may be able to obtain very fair results in practice.

The present is the second winter that this course has been conducted. Last year it met with great success, and many old students are now taking a second-year course. This move on the part of the management of the Montreal Technical School is to be heartily commended, and we wish the class continued success. It is hoped in the near future to give instruction in this subject to day students also, the difficulty hitherto having been to secure the services of practical demonstrators during the day time.

Autogenous welding, in addition to filling an important niche in mechanical engineering work generally, becomes, in the case of power plant operation, of inestimable value in preventing shut-downs of long duration. Expensive repairs to broken or fractured parts of the equipment, and even the necessity being obviated of replacement by entirely new pieces, have been and are being offset by the successful application of the process. It is incumbent, therefore, that men in charge of power plants, and particularly those directly responsible for advice concerning the carrying out of repairs, should be conversant with what is being accomplished in the direction of saving valuable equipment, which disaster may have overtaken, and of being able to discern when it is possible to have the work done, to all intents and purposes without removal from the plant. The progress of autogenous welding has been marked by rapidity and success due to merit, and it is our belief that near future development will increase its value even more so than in the past.

REFRIGERATION DEPARTMENT

MULTIPLE EFFECT ABSORPTION MACHINES.—I.*

By Edmund Altenkirch, Berlin.

ABSORPTION machines play, at the present time, a far more important part in the United States of America than in any other country, and new developments in this type of machine will consequently there obtain earliest recognition as to their scope.

In a paper published early in 1913 in the "Zeitschrift f. d. ges. Kalteindustrie," I have shown that the absorption machine, in regard to the cooling water heat flow, enjoys a great advantage as compared with the steam engine, and compression refrigerating machine; it being capable of following in an ideal manner, the changes of temperature in the heat imparting and absorbing media. This approximation to the Lorenz cycle is practically, in itself, nothing new. It is merely a recognition of a fact which we might have realized long ago; that the absorption machine, subject to certain essential exterior conditions, is more perfect than other thermo-dynamic machines.

Disregarding the processes within the machine itself, machines that operate by means of the vapor of pure fluids, require taking into account two extremal factors, cooling water and heat flow, in order to be generally reversible; namely, exceedingly large heat transmission surfaces and—provided latent heat does not come into play—unlimited large quantities of heat carried. Machines, however, which operate by means of vapor mixtures of binary and higher fluid mixtures, require for theoretical perfection only infinitely large surfaces for the flow of heat. The second condition disappears or is at least restricted. It is only carriers of limited quantities of heat that are capable of attaining the best approximation to the reversibility of the total process.

This advantage of the absorption machine in decreasing the temperature difference between the surroundings and the machine would practically in many cases permit an improvement in the utilization of the heat, if, on the other hand, it were not for the disadvantage that the temperature differences, and, with this, the irreversible heat losses within the machine, were not of themselves, so much greater. The latter, however, appeared until recently to remain theoretically and practically quite unavoidable and entirely beyond doubt.

I could show how, by returning the rich solution in counter-current through the absorber as well as by returning the weak solution in counter-current through the evaporator, the temperature differences within the machine itself could be reduced almost at will. The supply of heat to the evaporator, the emission of heat from the absorber, are by this means equally diminished. With stronger outflow of gas, the heat exchanger is eliminated, and by overheating with even more active flow of gas, it is also possible to furnish more cold than the quantity of heat supplied to the evaporator.

These improvements would, however, be incomplete if they were not supplemented in another direction. They apply so far, only to the driving engine of the absorption refrigeration machine, and to the absorption machine in a restricted sense. For this, however, the Lorenz cycle appears less important, when we consider that the evaporator is more usually heated by steam. The supply of heat is effected therefore mainly at a definite temperature point. Of course, the supply of heat may be effected in another way, but even then, the Lorenz cycle does not come fully into play, because the condenser is still always confined to a fixed temperature. The quantity of cooling water required is thereby predetermined in many cases, and a saving in the absorber amounts on the whole to very little.

Taking Full Advantage of Lorenz Cycle.

In order therefore to make full use of the great advantage of the Lorenz cycle in the condenser and evaporator as well, the pure fluid is to be replaced by a binary mixture. This was accomplished about twenty years ago by the German inventor Osenbruck. He allowed the absorption machine to work in the reverse direction and it only remained to apply to the machine working in this reverse direction the principal counter-current circulation of the solutions, so as to make the temperature differences within this machine as small as desired. I have more closely described this reversed absorption machine which can also be operated by a compressor and which consequently indicates an improvement of the compression machine, in the "Zeitschrift f. d. ges. Kalteindustrie," and the better to distinguish it have given it the name of "resorption machine." The condenser, therefore, becomes an absorber, to distinguish it from the absorber of the driving engine, but I have named it "resorber," while the evaporator becomes a generator which might be named a "distiller."

With the help of these improvements, the former theoretical inferiority of the absorption machine is changed to the opposite degree, and the new absorption refrigeration machine leaves as regards reversibility nothing to be desired. It possesses, in addition, the unequaled faculty of adaptation to the above described requirements of practice that the compression machine does not possess, and the advantages cannot fail to extend the field of usefulness of the absorption machine. A contribution to the theory of these machines shows, however, that it is not so easy, even with the overheating to raise the heat ratio of the absorption machine to two or three times what it was, in order to equal the economy of the compression machine driven by a steam engine, the thermo-dynamic reason for this being that by increasing the final temperature of the distiller, the average temperature of the absorber becomes correspondingly high. I will therefore indicate an entirely different method which, without making use of the increased temperatures, enables us, with the absorption machine, even as an exhaust-steam machine or at least as a back-pressure exhaust-steam machine, to furnish just as much cold for the volume of steam supplied as a good compression machine even when driven by a good steam engine.

Multi-Stage Absorption Machine.

This is effected by the multi-stage absorption machine, in which the absorption is effected in several stages. This was first described by the English engineers Cracknell and Stokes, in British letters patent 16,335, 1908. The weak solution gives off more gas in a second volatilizer, under lower pressure, before going to the absorber. The gas thus obtained is used in the second absorber, for the further enrichment of the solution coming from the first absorber. The pressure in the second absorber is higher than that in the first and corresponds to the pressure in the second volatilizer. This machine supplies a well dried vapor and is capable, even with warm cooling water, of working well, but consumes, for one kg. of usefully volatilized ammonia, on the whole more heat of volatilization and more refrigeration-calories than a simple machine, because the ammonia volume, expelled from the volatilizer by additional heat is again absorbed in the second absorber, without producing any cold.

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*From a paper read before the Second Section of the Third International Congress of Refrigeration, Chicago, in September last.

Another multi-stage absorption machine is that of Gardner T. Voorhees. The ammonia liquefied in the condenser in this machine passes first into a preliminary vaporizer. Here, at medium pressure and not very low temperatures, partial evaporation and cold production takes place, which serves for the preliminary cooling of the liquefied ammonia and of the water of condensation for the distilled-water ice making. The remainder of the ammonia passes into the principal evaporator. The gas developed in the preliminary evaporator is absorbed in an auxiliary absorber, under suitable pressure by the solution enriched in the main absorber and forced by a pump into the auxiliary absorber. The solution thus enriched passes into the volatilizer.

This machine, likewise in consequence of the higher initial concentration in the volatilizer, furnishes a drier vapor, and consequently requires comparatively somewhat less heat of volatilization and less refrigeration-calories. If we include in the useful refrigeration, the cold produced in the preliminary evaporation, which serves to cool the hot condensed water or enhance the useful refrigeration output—a question concerning which, however, a good deal might be said—the heat conditions are more favorable. It does not, however, go beyond a maximum which materially exceeds that of other good absorption machines working under favorable conditions, for the vapor produced in the evaporator by a given expenditure of heat, can, with a single evaporation, furnish no more cold than corresponds to its heat of evaporation.

The multiple effect absorption machines of Cracknell and Stokes and Gardner T. Voorhees, consequently hardly embody any progress in regard to utilization of heat. This may, however, be attained by the application to the machines in question of our system, in other words, by counter-current circulation and over-lapping of the temperatures. The over-lapping of temperatures, will be facilitated in both machines by the lower initial temperature of the volatilizer and in the Cracknell and Stokes machine by the high initial temperature of the absorber. Nevertheless, the object indicated above, a cold output greater than the supply of heat, is impossible or at best difficult of attainment by this means. The multi-stage absorption machine, such as has been worked out by me and my collaborator Tenckhoff will now be more closely described.

The multi-stage absorption machine of our system makes use of the already mentioned resorption machine. The vapor which leaves the evaporator does not pass directly into the absorber, but is first passed through such an independent resorption machine. The vapor is consequently reabsorbed in a resorber and again vaporized in a distiller. The ammonia produced in the volatilizer of the absorption machine consequently passes through two refrigerating machines, one behind the other; producing cold twice. Where a further resorption machine is introduced, three times, etc., the heat ratio can therefore be raised to an unlimited extent, if only the temperature differences in cold production are small enough to permit of several stages.

STAFF OF STEAM BOILER BRANCH, DEPT. PUBLIC WORKS, PROVINCE OF ONTARIO. READING FROM LEFT TO RIGHT:
D. M. Medcalf, Chief Inspector.
G. Guillet, Clerk and Bookkeeper. W. H. Bradt, Inspector. T. J. Main Inspector.
G. Drummond, Inspector. A. Brown, Inspector. W. Burns, Inspector.

Multi-Stage Absorption Machine Operation.

The rich solution in the absorber is driven by means of the pump into the volatilizer. Here, with the aid of a supply of heat and rising temperature, it is distilled. The weak solution leaves the volatilizer, and by means of a regulating valve, returns to the absorber, where, under heat abstraction and sinking temperature, it absorbs gas. The absorption machine driving parts need not differ from those of other absorption machines.

The gas developed in the volatilizer passes through a gas-drier into the condenser, is there liquefied, and, through the regulating valve, reaches the evaporator. This part of the machine is likewise unchanged. If the gas were to proceed directly into the absorber, the old machine would be complete, but instead, the gas passes into a resorber, and is there taken up by a relatively weak solution, which with loss of heat and reduced temperature, enriches itself. The rich solution thus obtained, passes a regulating valve, and enters the distiller. Here, yielding cold, consequently with increased heat and rising temperature, it dries off the gas again. The degased solution is forced by a pump back into the resorber to again absorb gas, and the gas that has been set free in the distiller passes finally into the absorber and begins the circle anew.

◆

Question.—A water tube boiler has 150 tubes 3¼ inches outside diameter by 15 feet long. What is the heating surface in the tubes.

Answer.—First calculate the circumference of a tube 3¼ inches outside diameter and divide the result by 12 in order to get the answer in feet. Multiply this result by 15 feet length, and we shall get the heating surface of one tube expressed in square feet. The total heating surface of the tubes will be 150 times this amount.

Thus $$\frac{3.1416\times3.25\times15\times150}{12} = 1914.41$$

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

A "BENNIS" COKING STOKER INSTALLATIONS.

THE accompanying description and illustrations refer to an installation of what is known as the "Bennis" high temperature, smokeless and gritless machine coking stoker at the London Paper Mills, Dartford, England. Coal is transported by means of Bennis U-link chain conveyors, feeding distributing shoots through openings in the bunkers. The plant consists of:

1.—A receiving hopper with supports placed outside the boiler-house on the bank of the river, in such a position that the cial can be deposited into the hopper by a crane and grab.

2.—An overhead coal storage bunker having a capacity of about 330 tons of coal.

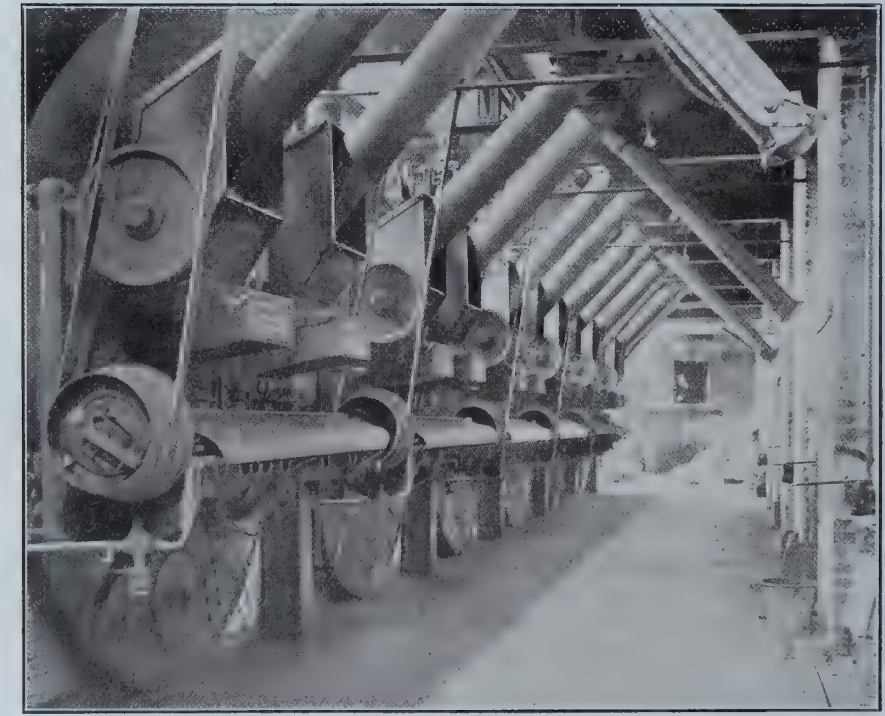

Fig. 1—A range of "Bennis" High Temperature Machine Coking Stokers keeping steam in the Boiler-house of the London Paper Mills.

3.—Bennis U-link chain conveyors with driving gear, shoots and all supports.

4.—Shoots to carry the fuel from the bunkers to the hoppers of the stokers by which the boilers are fired.

The method of operating the plant is as follows:—The coal is brought up to the wharf in barges. A grab load of coal is raised from the barge by the crane, and dumped into the receiving hopper from which it flows through an outlet into the chain conveyor, which is placed immediately beneath. The first portion of this chain conveyor is carried up an incline and the coal is thus raised to the level of the top of the bunkers. The conveyor then passes horizontally over the top of the bunkers, and the coal is dropped through openings into the storage bunkers beneath. The coal flows by gravity from the storage bunkers into the storage hopper, and a valve is placed at the end of each shoot to control the supply of coal.

The conveyor is of the well-known Bennis U-link chain type of which this firm has made a specialty during the last twenty years. It has a capacity of 40 tons per hour, and is driven through suitable reduction gear by a separate motor. The overhead coal storage bunkers are built over the firing floor; they are about 80 ft. long by 11 ft. wide, and have a total capacity of about 330 tons. The boiler-house wall is utilized for one side of the bunkers, while the other side consists of a reinforced brickwork wall. The bottoms of the bunkers are hoppered in shape, and are formed out of rolled steel plates with suitable stiffeners and connections.

A number of rolled steel joists run the whole length of the bunker to form supports and carry the weight between the stanchions. These longitudinal joists are supported in their turn by other transverse joists spanning the firing floor and carried at one end on substantial stanchions, resting on the floor; the other end being built into the wall of the boiler-house. These stanchions are also used for supporting one side of the main boiler-house roof, and a light roof is built over the top of the bunkers themselves. Access is given to the conveyor chamber over the bunkers by ladders and gangways, arranged so that all running parts are easy of access for inspection and lubrication. The bunker was designed to take full advantage of the existing buildings and to give the required storage without forming any obstruction to the movements of the boiler attendant. It is so arranged that future extensions can be easily affected.

The work of the U-link chain conveyors, as already stated, is to feed the coal to the bunkers which deliver it by means of openings into the distributing shoots which in turn deposit it in the stokers. The illustration, Fig. 1, affords a good view of this range of stokers with the shoots in position and in close connection with the bunkers immediately above.

It is of course essential that steam-raising in paper mills should be absolutely smokeless and gritless, because of the immense harm that can be done to both paper and pulp in various stages of manufacture should grits and smuts be emitted from the chimney and so find their way into the incomplete manufactures.

The Bennis coking stoker for paper and pulp mills has been referred to more than once in these pages, it is, therefore, sufficient here to point to the fact that the installation described was a development due to a satisfactory experience

SIEMENS BROS. DYNAMO WORKS | SIEMENS BROS. & CO.

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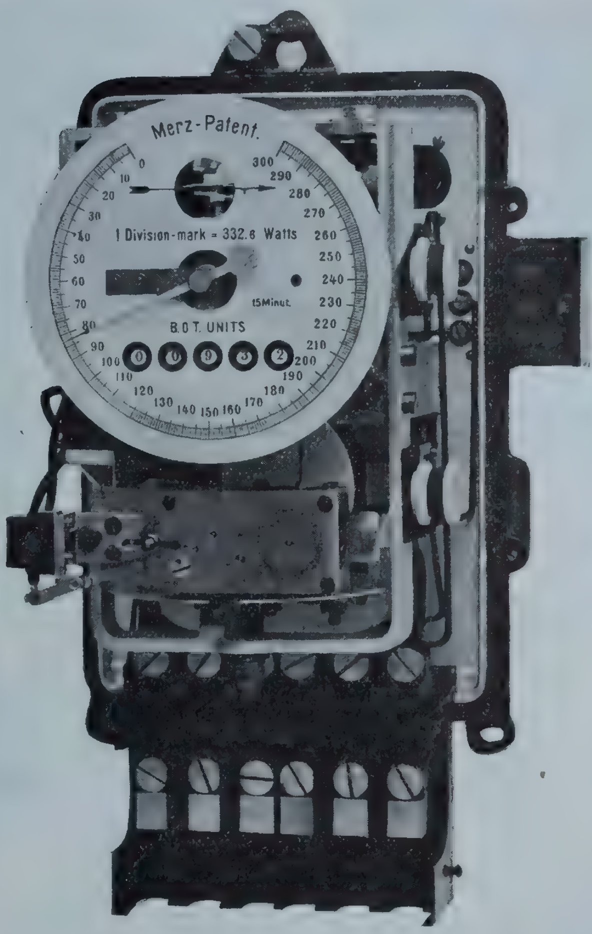
What the Meter does

1. Gives the kilowatt hours.
2. The highest load demanded in watts on a time average of say 15, 30 or 60 minutes.

The accurate measurement of these two quantities enables a true load factor system of charging to be adopted.

What can be done with the Meter

1. Charge an annual sum per K.W. year or Horse power year to cover capital and standing costs.
2. Charge a low straight rate per K.W. hour based on running costs and profit required.



SIEMENS LOAD FACTOR METER
(Combined Kilowatt Hour and Maximum Demand Meter)

The RIGHT METHOD and the RIGHT METER

Siemens Company of Canada Limited

HEAD OFFICE:
Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

with a similar installation at another of the Paper Co.'s mills.

The following are among a number of the advantages claimed for the Bennis coking stoker.

(1)—The power of rapidly lighting back which carries with it the power of feeding a much larger amount of fuel on to the furnace and getting it burnt.

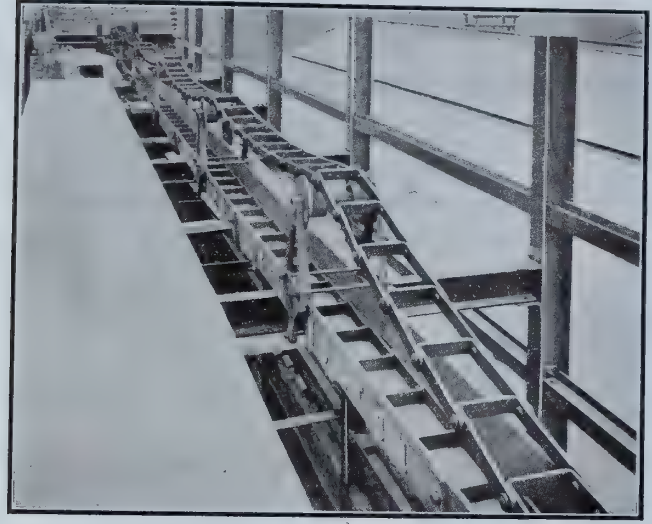


Fig. 2—"Bennis" U-link Chain Conveyor which in part of its travel is inclined to carry the coal to the level of the top of the bunkers. It deposits its contents by means of openings into the storage bunkers beneath. It forms part of the "Bennis" installation of coal handling plant in the boiler-house of the London Paper Mills.

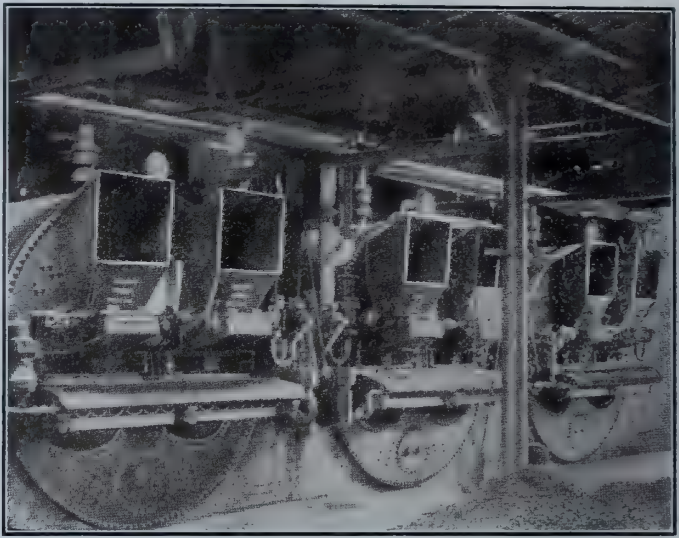


Fig. 3—This range of "Bennis" Smokeless and Gritless Coking Stokers is in operation at the A. E. Reed & Co. Farncombe Paper Mills.

(2)—A higher and more even furnace temperature than has hitherto been possible with coking stokers. This is induced by the scrubbing of the coke by the air blown into the fire through the very fine air spaces of the compressed air furnace bars.

"CHURTON" MOTOR.

(3)—Maximum flexibility attained by the power of controlling the air supply to the compressed air furnace bars and the adjustment of the damper of the boiler; a combination adequate to control the rate of combustion.

(4)—Combustion without smoke, grits or dust; the compressed air furnace cleaning into the ash-pit, which is a closed chamber.

(5)—Simple and easy manipulation, there being but two adjustments for the fireman to make, one which determines the rate of feed by turning a nut, and the other which regulates the air-feed by means of a valve.

(6)—Low cost of upkeep, the bars being few and the feed motion simple.

(7)—Stoking bars which keep the fire at a nicely-calculated distance from the boiler front, thereby obviating the hitherto unavoidable injury done to the whole furnace front by parts becoming red-hot.

(8)—Air-cooled fire-doors which prevent damage either to stoker or boiler.

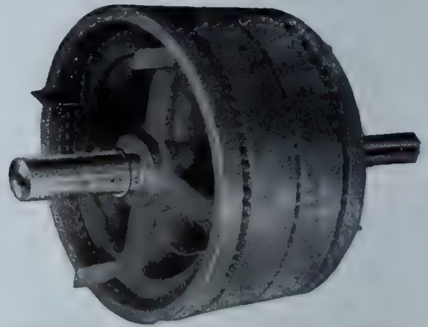
George H. Tod, Manning Chambers, Toronto, is the Canadian representative of the manufacturers, Edward Bennis & Co., Bolton, England.

◆

THE "CHURTON" INDUCTION MOTOR.

THE accompanying illustrations show a high grade induction motor as manufactured by the T. Harding Churton Co., of Leeds, England, who are specialists in producing alternating current motors. By giving unremitting attention to this particular line, they claim to have reached as near the acme of perfection as possible.

Noteworthy among the details of construction of Churton motors may be mentioned the connecting rings of the short current rotor. The usual methods of connecting these rings to the rotor conductors by bolts and nuts, or by riveting, are not infrequently causes of trouble due to the effects of continual expansion and contraction, and the efficiency of a motor with the rotor so constructed may seriously depreciate after working for some time. Another method of connecting the conductors by wires interlaced around the ends and soldered together has the disadvantage that the solder is apt to be melted off by temporary heavy overloads that the motor should sustain without injury. To overcome these difficulties the Churton people introduced their "cast welded" system, in which the connecting rings are, by a special process, welded direct to the conductors, thus obviating joints of any kind. This method has proven entirely successful, the rotors so constructed being practically indestructible.



"CHURTON" SHORT CIRCUIT ROTOR.

The Stuart Machinery Co., Ltd., of Winnipeg, Man., are the Western Agents for "Churton" motors, and carry a stock of sizes ranging from 1 to 50 h.p.

◆

Arthur Grace, recently elected Commissioner of Public Works, Lethbridge, Alta., went there as engineer in charge of the construction of the Alberta Railway & Irrigation Co.'s irrigation works. He has had lengthy experience as an engineer in railway construction, and has had considerable civic experience in the construction of waterworks. He is an authority on gravity systems.

Good Reasons

why
you should use

D. K. McLAREN'S

Genuine British Oak-Tanned

Leather Belting

Only the best centres of carefully selected hides are used, and these are tanned by the slow, old-fashioned British Oak method which assures maximum strength and durability.

It has a grip that means less slip—hence the transmission of more power.

It is thoroughly stretched before being placed on the market, assuring but little attention when in service.

May we have the opportunity of furnishing you with references and full particulars?

Genuine Oak

A Guarantee that is on every piece of D.K.McLaren's High Grade Belting.

D. K. McLAREN Limited

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64 Prince William St.

Toronto
200 King St. W.

Vancouver
37 Alexander St.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

Electrical

Neepawa, Sask.—The ratepayers recently voted $18,000 for the erection of an electric power plant.

Winnipeg, Man.—The Kildonan council have applied to the city of Winnipeg for the lighting of Main St., from the limits of the city to the municipality.

Ottawa, Ont.—The Minister of Railways has approved the plan of the Cedar Rapids Power Company for its proposed transmission line from the Rapids to Cornwall.

Toronto, Ont.—Among the municipalities which voted for Hydro-Electric power this week were, Wallaceburg, Hanover, Fergus, Elora, Strathroy, Tilbury and Chatham.

Hamilton, Ont. — W. C. Hawkins, managing director of the Dominion Power and Transmission Co., believes construction work on the new steam power plant will commence in March.

Paisley, Ont.—The new council will deal with the extension of the waterworks, and the electric lighting system will be discussed, as the power is not equal to the number of lights being used

Sydney, N.S.—The Broughton Coal & Iron Co., Broughton, N.S., are considering an electric plant capable of taking care of 2,000 tons of coal per day, the central power plant to be located at Broughton.

St. Catharines, Ont.—The Niagara, St. Catharines and Toronto Railway is erecting a power house on Welland Ave., 40 x 35 feet, costing $45,000. The Canadian General Electric Co. is supplying the equipment.

Yarmouth, N.S.—The special committee recommends that a contract be given to the Northern Electric & Mfg. Co., of Montreal, for apparatus, etc., for a 3 circuit system, compressed air plant, 60 cycle, 3-phase, 220 volt circuit air compressors, motors, etc., at $2,000; battery switchboard, etc., at $1,587; wire, labor, etc., at $425.

London, Ont.—The remaining equipment necessary for the furnishing of hydro power to operate the street railway system has been shipped from Montreal, and will be completely installed by the end of February. The Company is using only part hydro at the present time, but after March 1 will be using it exclusively.

Quebec, Que.—The Provincial Waterways Commission, of which the Hon. S. N. Parent is president, has completed its report. It is understood that the Commission favors the harnessing of the St. Maurice River in the vicinity of Le Tuque by the building of a dam, which will make possible the development of 500,000 horse-power for industrial purposes.

Hamilton, Ont.—The Dominion Power & Transmission Co. have prepared plans for their steam auxiliary plant, which will occupy 14 acres east of the National Steel Car Co. plant. The main building will be 380 x 170 ft. by 50 ft. high. The transformer house will be 75x250 ft. Two units will be installed this fall, of 13,400 h.p. capacity. A unit will be added each year until the capacity is 88,000 h.p. W. C. Hawkins, managing director.

Municipal

Galt, Ont.—The city will spend $15,000 on its waterworks.

Woodstock, Ont. — Embro village wants Hydro-Electric power.

Guelph, Ont.—The city will spend $17,000 on two new street cars and a new feed wire.

Brantford, Ont.—Preparations are being made to connect the gas pipes with the old purification plant.

Hamilton, Ont.—A by-law providing $335,000 for extensions to the Hydro-Electric system was passed on Jan. 1.

Nelson, B.C.—The ratepayers have voted in favor of purchasing the street railway. The city recently took over the gas works.

Toronto, Ont.—The ratepayers on January 1 voted in favor of the city acquiring a portion of Toronto and York Railway.

London, Ont.—The by-law to loan $25,000 to the Grobb Mfg. Co., who will take over the London Foundry, did not pass at the municipal election on Jan. 1.

St. Vital, Man.—Third readings have been given two by-laws to provide $200,000 for water and sewer extensions, and to provide $35,000 for the new fire hall.

Athabasca Landing, Alta.—On Jan. 12 the ratepayers voted on a by-law providing $85,000 for completing and extending the present waterworks system.

London, Ont.—The Greene-Swift Co. have been given a franchise to lay steam pipes across Carling Street to heat the north half of Dundas Street, from Talbot to Richmond.

Davidson, Sask.—The ratepayers have voted in favor of spending $8,500 on an electric light plant, which is to be purchased from the Canada Gas Producer Co., Barrie, Ont.

Chatham, Ont.—The city is contemplating giving $410,000 for the Chatham Gas Co.'s gas and electric plants. It will be necessary to spend $50,000 to make the electric plant serviceable for the distribution of Niagara power.

Berlin, Ont.—Four rural districts of North Waterloo are preparing to take Hydro power. Their names and rates for 50 h.p. are as follows:—St. Jacob's, $29.08; Conestogo, $36.59; St. Clement's, $42.68; Floradale, 40 horse-power, $51.57.

Montreal, Que.— Controller Godfrey will recommend the building of a pumping station on the banks of the Lachine Canal opposite the present pumping station at Point St. Charles, with three pumps, costing $70,000, and to be finished in three weeks. This would be used only in case of an accident to the conduit.

Cyclone Cleaner with "Norivet" freely swinging arm head.

Clean Boilers Increase Profits

When your boilers are coated with scale, you are burning up money, which a LIBERTY CLEANER would save. A light coating of scale may mean a waste of 10%, and a ½-inch of scale a 50% loss of fuel.

Are You Sure Your Boilers Are Clean?

If you are not, it will pay you to investigate, and you should make your investigation THOROUGH. While the tubes in front may show little indication of scale, the centre may be heavily coated. A Liberty Cleaner will find the scale, and if you are in doubt as to their condition, let us send you one with which to make an investigation. If the tubes are clean, you don't need a Cleaner, and it can be returned to us without any expense to you.

Send postal for Catalogue.

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6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

"TWINS" EXCITE ADMIRATION

Because They Earn It

Think of a TWIN when you hear the word STRAINER

The installation of a Twin Strainer on your water supply line eliminates troubles, worry, waste of time and expense—because

It has two straining baskets—that may be cleaned alternately, thus permitting continuous operation.

It has but two valves—they are of the gate type and are always tight.

It gives a direct flow with minimum friction loss, insuring easy operation with no waste of energy.

In fact, a Twin Strainer is an insurance policy in active service.

Designed to protect and built to last.

Write for our bulletin.

THE TWIN STRAINER.

ELLIOTT COMPANY

6902 Susquehanna Street, PITTSBURGH, PA.

Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:

Willams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

Refrigeration

Vancouver, B.C. — The Vancouver-Prince Rupert Meat Co., 125 Hastings St. W., will erect a cold storage warehouse.

Victoria, B.C.— The Swift Canadian Co. have completed a new $200,000 branch here. The refrigerating machinery, of 35 tons capacity, was installed by Huetteman & Cramer, Detroit.

Contracts Awarded

Winnipeg, Man.—The Board of Control will instal a duplex steam booster pump at the new King George hospital, and have awarded the contract to Cotter Bros. for $550.

Winnipeg, Man.—A contract has been awarded by the city to the Dominion Equipment Supply Co., representing the Dean Steam Pump Co., of Holyoke, Mass., for the supply of two new deep well pumps, with a guaranteed capacity of 600,000 gallons per day, costing $7,200 each, and guaranteed to be in operation by April 1.

New Incorporations

The Star & Hydro-Electric Co., Ltd., has been incorporated with a capital of $399,000, with head office at Montreal, to carry on business as electricians and manufacturers.

The Hilton Electric Co., Ltd., incorporated at Ottawa, capital $50,000, to carry on the business of electric engineers and contractors, and as dealers in and manufacturers of machinery, tools, etc., at Montreal, Que. Incorporators: Wallace R. Hilton, Aaron Issenman, etc., Montreal.

Trade Gossip

Winnipeg is considering the appointment of an assistant to City Engineer Ruttan to succeed the late R. D. Wilson.

Toronto, Ont.—The Toronto Waterworks Committee have just placed an order for two large pumping units. One unit consists of a 7½-million gallon Canadian Allis-Chalmers turbine pump, direct coupled to a Belliss & Morcom 580-600 h.p. triple expansion engine running at 300 r.p.m. The other unit is a 20-million gallon Canada Foundry turbine pump driven by a Belliss & Morcom 560-580 triple expansion engine running at 250 r.p.m. Both engines will run condensing.

Swedish General Electric Ltd.—The business heretofore carried in under the name of Kilmer, Pullen & Burnham, Ltd., will be continued by the Swedish General Electric, Ltd. The change of name has been adopted on account of its expressing better the class of business being conducted. Frank Pullen is president, the head office is in the Kent Building, Toronto, and branch offices are established at Montreal. Calgary and Vancouver. Swedish generators, motors and electrical equipment of all kinds are the firm's specialties, over 100,000 h.p., of these being already installed in Canada.

The Canadian Ingersoll-Rand Co. held their annual gathering of salesmen and officers at Sherbrooke last week. Those attending were:—E. W. Gilman, Montreal, general manager; N. M. Campbell, Montreal; J. W. Bell, Vancouver, B.C.; S. A. Williams, Lethbridge, Alta.; Wm. Carter, Winnipeg; G. R. Southee, Cobalt, Ont.; C. C. Hoyt, A. A. Bowman, B. H. Lyons, Toronto; S. W. Dugan, E. S. Winslow, J. McGuire, J. W. Davis, E. A. Lunderville, Montreal; J. P. Cotter, Sydney, C.B. Conferences were held every day, and on New Year's Day, the proceedings terminated with a dinner to the staff.

The Smart-Turner Machine Co., Hamilton, Ont., have recently secured the following orders:—The Armstead-Wolvin Co., Port Arthur, Ont., automatic feed pump and receiver equipment; the Black Donald Graphite Co., Calabogie, Ont., one force pump; the Corporation of Forest, Forest, Ont., duplex pump; Armstrong, Whitworth of Canada, Ltd., Longueuil, Que., one duplex pump; the General Hospital, Brantford, Ont., automatic feed pump and receiver equipment; Davidson & Smith Elevator Co., Port Arthur, Ont., automatic feed pump and receiver; Harbor Commissioners of Montreal, Que., duplex pump; the Gold Lion Brewery Co., Valleyfield, Que., simplex vacuum pump.

Personal

H. E. Pawson, has been appointed electrical engineer for Prince Albert, Sask. He was formerly with the Phoenix Dynamo Co., of Bradford, Eng., and more recently with the Appalachian Power Co.

J. F. H. Wyse, consulting engineer, 34 Victoria Street, Toronto, has been appointed organizer and engineer of the Ontario Safety League. He has, for a number of years, been associated with the Ontario Railway and Municipal Board in a consulting capacity.

Arthur Reid, recently elected Commissioner of Public Utilities, at Lethbridge, Alta., is a Newfoundlander. When a young man, he entered the shops of John McDougall & Co., Montreal, and served six years as a machinist apprentice. He subsequently went to Glasgow, Scotland, and for some time worked in the largest marine engineering shops on the Clyde. He then took to sea life for three and a half years, working as a marine engineer and was awarded a first-class certificate of the British Board of Trade. He returned to Montreal to the firm of McDougall & Co., and was employed as erecting engineer, making a specialty of electrically driven turbine pumps. It was while on this job he was sent to Lethbridge to instal the waterworks pumps, and his services were secured by the city.

Catalogues

The Canadian General Electric Co., Ltd., Toronto, have sent us a copy of bulletin No. A-4131, dealing with storage battery, industrial and mining locomotives, with special reference to the storage battery type, explaining its principal features. Illustrations are given of the various types made by the company, also locomotives in operation, together with views taken from assembly drawings.

The Simplex Manual.—On the press, for the Simplex Wire and Cable Co., Boston, is a 92-page booklet which "just fits the pocket" as well as the needs of every electrical man who has anything to do with wiring problems. It is full of tables and other information of all sorts about insulated conductors and other matters electrical, and is equipped with an unusually complete index. Printed on a fine thin paper, and bound with stiff covers, the book is to be distributed gratis to those who ask for it.

MORRIS CHAIN-BLOCKS,
TRY ONE—IT WILL GIVE YOU A LINE ON THEM ALL.
MORRIS HAND-CRANES.

Classified Advertisements

Those who wish to sell or buy a business, obtain competent help, connect with satisfactory positions or secure aid in starting new enterprises, should not fail to use the Want Ad. Page of The Power House.

Do you want to sell or buy a second hand engine or any other equipment? Let The Power House pick out a seller or buyer for you.

There is always some one looking for just such proposition as you have to offer.

RATES (payable in advance):—2c. per word first insertion, 1c. per word subsequent insertion, 5c. additional each insertion when Box Number is required. Each figure counts as one work.

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LIBERAL COMMISSIONS TO DEALERS AND others handling Vulcan Soot Cleaners; applied to all types of boilers. Vulcan Tube Cleaning Systems, Limited, 42 Craig St. West, Montreal. (tf)

SITUATION WANTED

EXPERT ERECTING AND OPERATING ENgineer, Canadian (age 28), now employed, wants change. Saskatchewan and Alberta certificates, references furnished. Chas. Fenwick, Wapella, Sask. (2)

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BELTING FOR SALE — 800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting & Supply Co., 5 Queen Street, Montreal. (tf)

ENGINEERS

ENGINEERS DESIRING VALUABLE DATA on Boiler Operation, should write for our new booklet—it's free if you tell us where you saw our ad.
The Federal Graphite Mills, Cleveland, Ohio.

MISCELLANEOUS

PRACTICAL COURSES BY MAIL IN STAtionary Engineering, Traction, Marine, Gasoline, Automobile, Locomotive, Electric Lighting and Power. Write, stating in what you are interested. Canadian Correspondence College, Limited, Dept. P.H., Toronto, Canada.

MECHANICAL DRAFTSMAN

8 years' experience on locomotives, motors, pumps, engines and general engineering. Technical education. Employed with one of the largest concerns in the States. Can furnish best of references. Box 22, The Power House, 143 University Ave., Toronto.

Boiler Preservative

acts on the iron—not on the water. It is a boiler treatment in a class by itself.

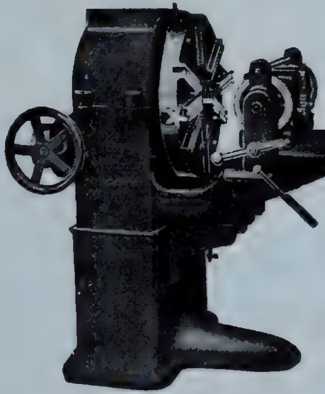
Water treatments are only partially successful, because the scale-forming sediment in water changes with seasons, climates and localities.

"MAGIC" removes scale and oil first, and then prevents scale forming. It stops pitting, corrosion and minor leaks.

"MAGIC" saves the boiler and much labor.

A trial will convince you—write us.

Canada Supply & Contracting Co., Limited
220 King St. W., Toronto, Ont.



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THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES

A Very Desirable Machine for

PLUMBERS and STEAM FITTERS

Manufactured by

THE ARMSTRONG MFG. CO.
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NEW YORK CHICAGO

THE CANADIAN TURBINE WATER WHEEL
CONSERVE THE WATER POWERS
TRADE MARK.

Chas. Barber & Sons

Meaford : Ontario

WATER POWER EQUIPMENT ONLY

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DIXON'S FLAKE GRAPHITE

The perfect lubrication afforded by this natural product in combination with oil or grease works high economies in the saving of power by the reduction of friction.

The fine, unctuous flakes build up a friction-reducing veneer over the bearing surfaces which prevents the metal-to-metal contact which causes wear and wasted power.

Use Dixon's Flake Graphite in your bearings and you will minimize your friction load and your bearing renewals.

Send for "Valuable Graphite Products" Booklet No. 222

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE CO.

Established 1827.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
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THE BAR-KEEPER'S FRIEND

Best known Metal Polish. Guaranteed forever. Largest sale in the World.

BEATH
CRANES
CHAIN BLOCKS
TROLLEYS
OVERHEAD RUNWAYS

Solve Coal, Machinery and Merchandise Handling Problems.
Hand, Pneumatic and Electrically Operated.

Tell us what you wish to do, and we'll suggest the proper equipment for you.

W. D. BEATH & SON, Limited
Engineers and Manufacturers
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Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

H. Mueller Mfg. Company, Ltd.
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Canadian Oil Companies, Limited

TORONTO MONTREAL ST. JOHN
HALIFAX WINNIPEG
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OILS

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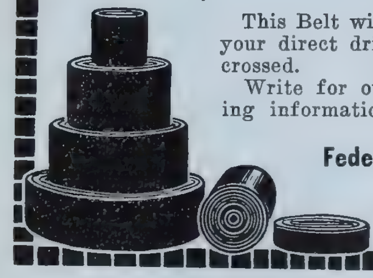

This Belt will save you money on all your direct drives, whether straight or crossed.

Write for our free booklet on Belting information.

Federal Engineering Co., Ltd.
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Don't Use Boiler Compounds

Which are always injurious to boilers and valves.

We guarantee an absolute Metal Clean Boiler, when there is sufficient exhaust steam. Get the Nobis habit around your power plant.

Best References

The Nobis Engineering Co.

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ENGINEER, MANUFACTURER
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Founded 1880

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329 King St. West, Toronto
Phone Adelaide 3669.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

HON. J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

Good Threads—

clean, and up to size—are more easily and quickly cut with the minimum **wear and** tear on taps and dies, by using **Emulsive Lard Oil** as a lubricant.

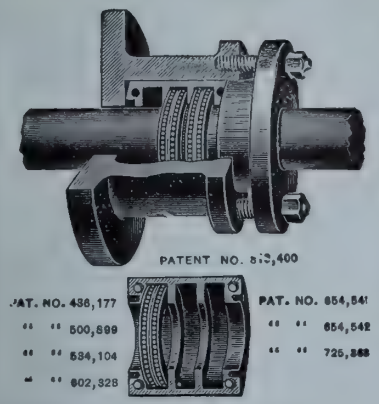
For ordinary screw cutting and Turret lathe work use one gallon of Emulsive Oil to 15 gallons of water.

For drilling use one gallon of Emulsive Oil to 30 or 40 gals. of water.

Write for prices.

Commercial Oil Co., Ltd.

Hamilton, Ont.



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HOLMES'

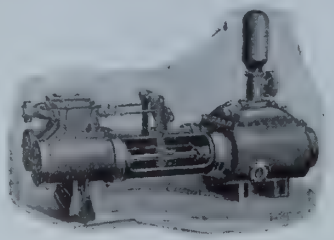
Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

Have You Tried Them?
They Are PUMPS That LIVE.



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Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

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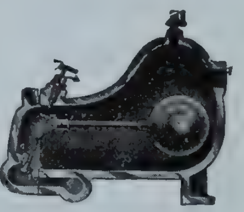

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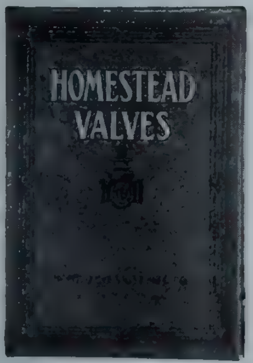

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Quarter Turn Valves have demonstrated their superiority under severest tests. Engineers always come to "Homestead" when other valves fail. Durable, simple, easy to operate. Always tight. Never stick.

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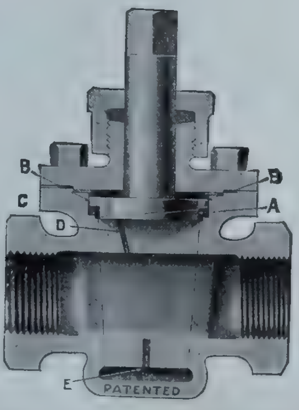

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You will either overtax it, which will necessitate costly repairs, or else you won't get all the power that is in it. The proper way to accurately determine the speed of any engine or machine is to use a

Starrett Speed Indicator

It registers any speed without heating of parts. Equally good for motors, gas engines, line shafting, or any revolving machine. Rubber tips for centred or pointed shafts. Send for Starrett Catalog No. 20CD.

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Chipping Out Scale

by hand is almost as antiquated as filling a boiler with a bucket.

Neither are conducive to that greater economy and higher efficiency which should obtain in the Power House.

WALKER'S ELECTRIC BOILER COMPOUND

fed in with the feed water will quickly rid tubes and sheets of all adhering scale and its continued use will keep your boilers clean and prevent any recurrence of scale troubles.

Send us a gallon of feed water for analysis, and let us ship you a barrel of "Electric" on trial.

And we have also a complete line of Power House Supplies. May we tell you about them?

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COMPANY, LIMITED
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This Company makes a specialty of inspecting boilers under construction, and issues an official Certificate of Inspection, as required by the Laws of Ontario which came into force on the 1st July.

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TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

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The Detroit "500" Air Compressor Lubricator gives constant lubrication under every condition of service. The rate of feed never varies when changing from pressure to unloading or when returning from unloading to pressure.

The Detroit "500" cannot be robbed of oil and cannot be affected by changing conditions in the cylinder.

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The bullseye gauge and sight feed glasses are kept tight and won't break. This lubricator will withstand the roughest service.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

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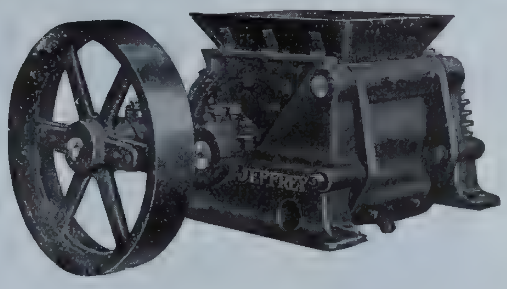

Have you Been Compelled to substitute Lump Coal, while your boilers are equipped for stoker size coal?

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Reduces Lumps or Run-of-Mine Coal to stoker or any desired size in a single operation.

Will crush more coal with less power than any other machine on the market.

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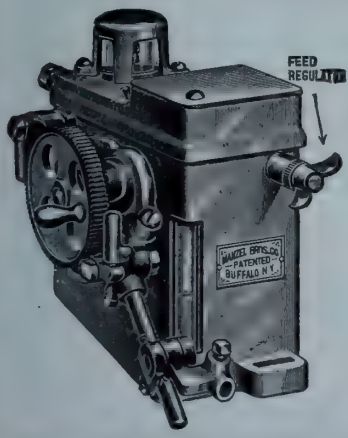
Virtually—that's what the

Manzel Sight Feed Oil Pump

accomplishes for you.

Installed in your Power House it will deliver to your engine cylinders just the right quantity of oil—per stroke—whether the engine be running fast or slow, whether the load be heavy or light.

And it's the liberal, but not wasteful lubrication, that the "Manzel" effects, that causes it to economize so wonderfully.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MANZEL BROS. CO.
PATENTED
BUFFALO N.Y.

Prove it for yourself by letting us lend you one for 30 days' free trial. After you have tried it return it unless you're convinced.

So write now.

The Twin City Oil Co.
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When GREASE Gives More Uniform Lubrication, Is Better and Much Cheaper?

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Grease when used in this Grease Cup is under perfect control until the last drop is used.

The efficiency of this Grease Cup cannot be affected by centrifugal force when used on loose pulleys.

REMEMBER we guarantee it to save 50% over any other system.

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Write for particulars.

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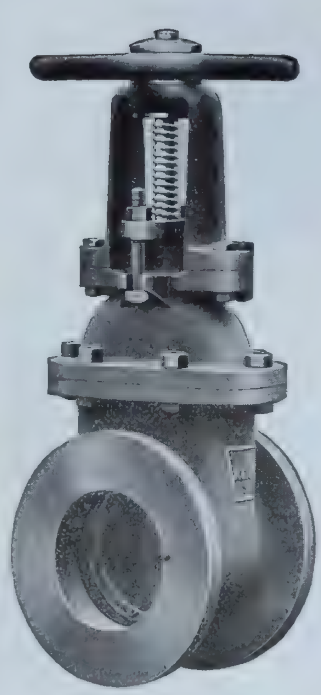

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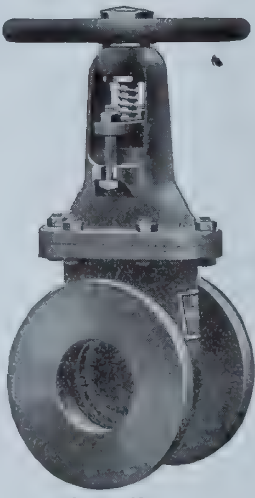

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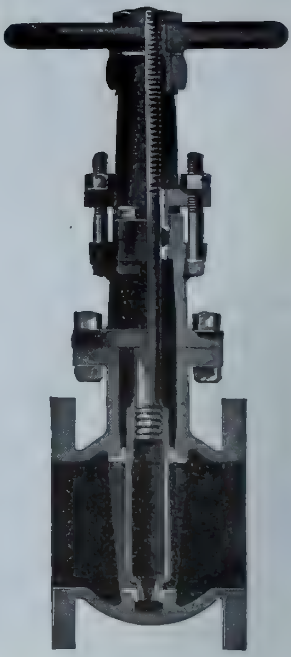

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Walkerville, Ontario

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Harris Heavy Pressure

Makes sunshine for the Engineer and Machinist. It is a High-grade Babbitt at a medium price, recognized as the best Babbitt Metal for all general machinery bearings, and answers in

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From Germany

PEROLIN is the first and only METAL treatment for cleaning and preservation of the interior of boilers.

Boiler metal is everywhere and always the same, and is the ONLY proper thing to treat.

It is the ounce of prevention for NEW boilers, and the pound of cure for OLD ones.

NEW BOILERS can be put in a perfect state of preservation in from 15 to 30 days with PEROLIN, which will positively prevent scale formation, pitting and corrosion.

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PEROLIN has proved this in thousands of plants throughout Europe and this continent, and not in a single instance has it failed where directions have been followed.

When hearing of anything for the first time, especially when such extravagant claims are made for it, it is human nature to incline towards skepticism and disbelief.

BUT, when you can PROVE in your own plant, at our expense, and on your own terms, that the above statements are true, is it not good business judgment to ask us HOW?

If this appeals to you take it up with our firm, or write us for further information.

Perolin Company of Canada Limited

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RETURN STEAM TRAP FOR FEEDING BACK HOT

Founded in 1878

Export

GREAT SAVING IN COALS AND WORKING EXPENSES.

INCREASED BOILER EFFICIENCY.

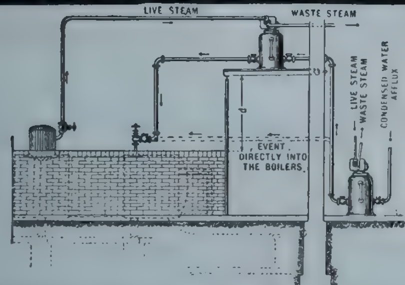
INCREASED LIFE OF BOILER.

MINIMUM OF BOILER INCRUSTATION.

SCHNEIDER & HELMECKE-MAGDEBURG Special Works for Steam Traps

CONDENSED WATER DIRECT TO BOILER, WITHOUT PUMP.

THE MOST RATIONAL



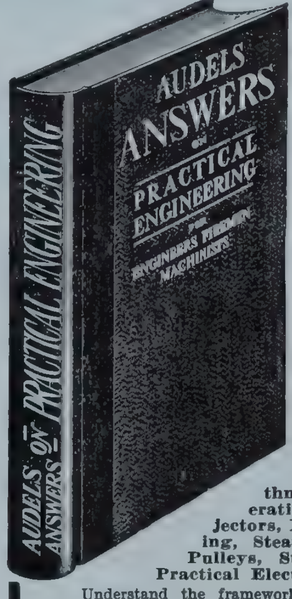
SELF-ACTING BOILER FEED

Direct Boiler Feed is also possible with one Return Steam Trap according to the situation.

Dominion Sugar Company, Ltd. We received your favour of the 5th inst. and noted its contents. To our great satisfaction we are able to inform you that your Return Steam Traps, are working excellently. We have now installed all four, which have worked faultlessly right away from the commencement. — One double Return Steam Trap suffices for conveying the condensed water from 6 Sperber drying apparatus directly back to the boilers. — *Since the Return Steam Traps were installed the feed pump for the boilers of the splitting-drying department has not been used.* — The saving in coals is considerable, since by aid of the Return Steam Traps we can now easily keep up full steam, whereas previously we had constantly to force the boilers to the utmost. After the experience gained with your condensed water Return Steam Traps we must admit, that no plant ought to be without the same. The feed pump has always been a unisance to us.

We leave it to your discretion to make whatever use of this you please.

Wallaceburg (Canada), Ont., Novbr. 22 nd, 1909.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AUDELS ANSWERS ON PRACTICAL ENGINEERING

ENGINEERS

THIS book deals largely with the foundation principles which govern the practice of steam engineering. Nothing so soon condemns the applicant as want of knowledge of the every day practice and simple laws relating to the care and management of a steam plant.

No one is expected to know everything, but all are required to be familiar with certain facts which may be called "the beginning of things."

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Understand the framework of which your work is but a cross bar. Know something of the cause of which your work is but an effect. Know something of the effect of which your work is the cause. And, above all, know why it is done one way and not another.

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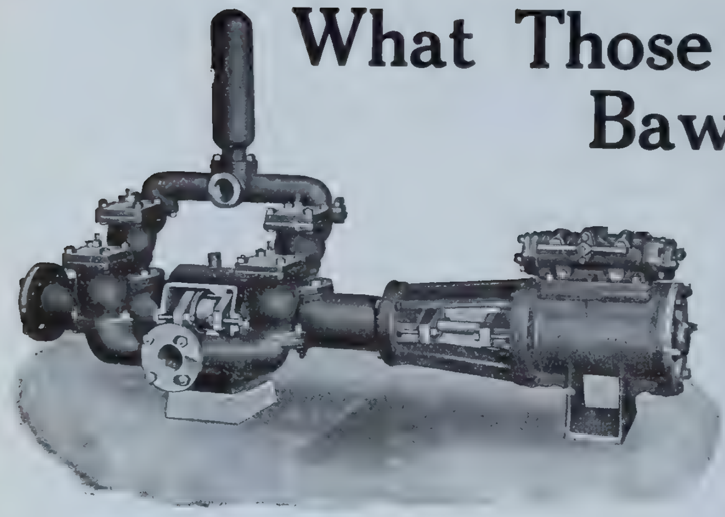

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"I would never know I had a pump, as it needs no attention."

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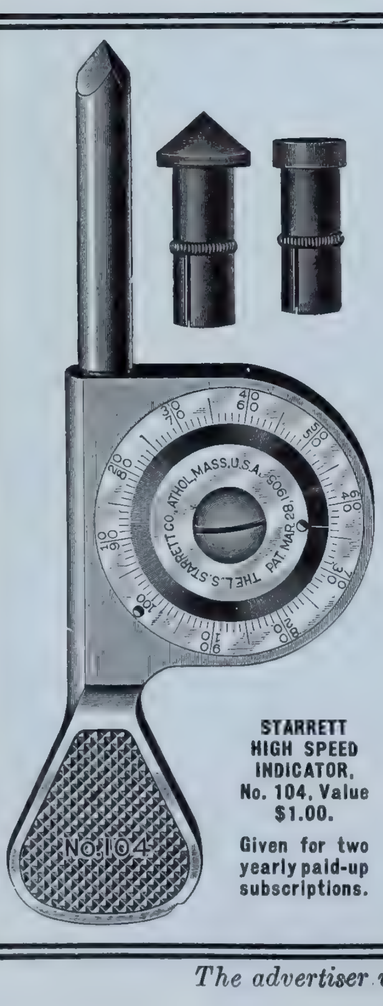
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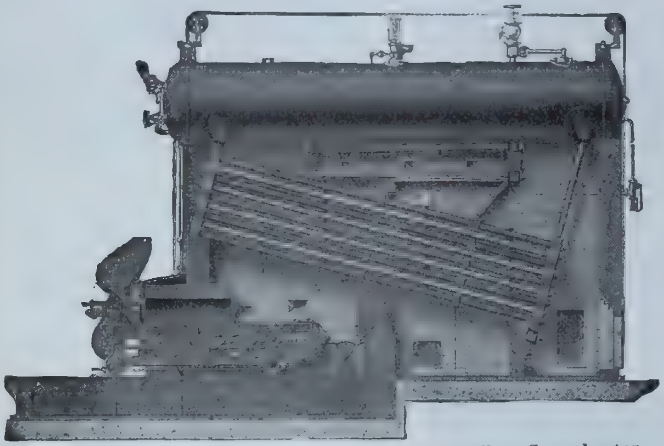

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- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- Hare Eng. Co., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Nobis Engineering Co., Toronto.
- Peacock Bros., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Boiler Feed Regulators.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Hare Eng. Co., Toronto.

Boiler Mountings.
- Babcock & Wilcox, Montreal.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Darling Bros., Montreal.
- Lunkenheimer Co., Cincinnati, O.

Boiler Tube Cleaners.
- Garlock Packing Co., Hamilton, Ont.
- Liberty Mfg. Co., Pittsburg.
- Vulcan Tube Cleaning Systems, Ltd., Montreal.

Boilers, Horizontal, Return, Tubular and Watertube.
- Babcock & Wilcox, Montreal.
- Goldie & McCulloch Co., Galt.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co. of Canada, Limited, Toronto.
- Engineering Works of Canada, Ltd., Montreal.
- Frick Co., Waynesboro, Franklin Co., Pa.
- Hamilton Co., Wm., Peterborough, Ont.
- Jenckes Machine Co., Sherbrooke, Que
- Jones Underfeed Stoker Co., Toronto.
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Wks, Montreal.
- Polson Iron Works, Toronto.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Wks. Co., Brantford

Boilers, Marine, Locomotive and Vertical.
- Babcock & Wilcox, Montreal.
- Goldie & McCulloch Co., Galt.
- Can. Allis-Chalmers, Ltd., Toronto.
- Jenckes Machine Co., Sherbrooke, Que
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Wks, Montreal.
- Polson Iron Works, Toronto.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Wks. Co., Brantford

Brine Coolers.
- Frick Co., Waynesboro, Franklin Co., Pa.

Brine Tanks.
- Frick Co., Waynesboro, Franklin Co., Pa.

Cables, Aerial and Underground.
- Eugene F. Phillips Electrical Works, Ltd., Montreal.

Cans, Oily Waste.
- Jas. Morrison Brass Mfg. Co., Toronto.

Car Wheels.
- American Pulley Co., Philadelphia.

Carbon Brushes.
- Rougier Freres, Montreal.
- Lunkenheimer Co., Cincinnati, O.

Carbon Paint.
- Commercial Oil Co., Hamilton.

Carriers.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cast Iron Fittings.
- Lunkenheimer Co., Cincinnati, O.

Cast Plate Track
- Orenstein-Arthur Koppel Co., Pittsburg.

Castings, Brass and Iron.
- Lunkenheimer Co., Cincinnati, O.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Cement, Fireproof.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Cement Machinery.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.

Chain Blocks.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Slings.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Charging Cars
- Orenstein-Arthur Koppel Co., Pittsburg.

Chemicals.
- Dearborn Chemical Co., Chicago.
- C. C. Snowdon, Calgary.

Circuit-Breakers.
- Engineering Works of Canada, Ltd., Montreal.
- Can. Gen. Elec. Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Siemens Co. of Canada, Ltd. Montreal.

Coal.
- Ohio & Michigan Coal Co., Detroit, Mich.

Clutches.
- Elmira Machinery and Transmission Co., Elmira.
- Waterous Engine Wks. Co., Brantford

Coal and Ash Conveyors.
- Babcock & Wilcox, Montreal.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Hare Eng. Co., Toronto.
- Jeffrey Mfg. Co., Columbus, O.
- Geo. H. Tod, Toronto.

Coal Handling Machinery.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Hare Eng. Co., Toronto.
- Geo. H. Tod, Toronto.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.
- Jeffrey Manufacturing Co., Columbus.

Coils.
- Frick Co., Waynesboro, Franklin Co., Pa.

Collars.
- Can. Bond Hanger & Coupling Co., Alexandria, Ont.

Cold Storage Insulation.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Robinson Bros. Cork Co., Toronto.

Condensers.
- W. H. Allen Son & Co., Bedford, Eng.
- American Steam Pump Co., Battle Creek, Mich.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co. of Canada, Limited, Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- Goldie & McCulloch Co., Galt.
- John McDougall Caledonian Iron Wks, Montreal.
- Hare Eng. Co., Toronto.
- Waterous Engine Wks. Co., Brantford
- Arctic Ice Machine Co., Canton, Ohio.

Condensers, Ammonia and Steam.
- Frick Co., Waynesboro, Franklin Co., Pa.

Cold Store Doors and Windows.
- Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
- G. M. Davis Regulator Co., Chicago.

Conduits.
- E. Leonard & Sons, London, Ont.
- Can. H. W. Johns-Manville Co., Toronto.

Consulting Engineers.
- Bayfield & Archibald, Vancouver, B.C
- Chas. Bishop, M.I.C.S.A., Montreal.
- de Gaspe Beaubien, Montreal.
- John T. Farmer, Montreal.
- Fetherstonhaugh & Co., Montreal.
- Walter J. Francis, Montreal.
- Jacobs & Davies, Inc., Montreal.
- Pratt & Ross, Toronto.
- J. M. Robertson, Montreal.
- J. M. Shanly, Montreal.
- Surveyor & Frigon, Montreal.
- A. V. Tracy-Gould, Montreal.

Contractors, Structural Steel.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.

Conveyor Machinery.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Engineering Works of Canada, Ltd., Montreal.
- Jeffrey Manufacturing Co., Columbus.
- Geo. H. Tod, Toronto.
- Waterous Engine Wks. Co., Brantford

Cooler Doors.
- Jones Cold Store Door Co., Hagerstown, Md.

Cork Insert Pulleys.
- American Pulley Co., Philadelphia.

Cork Insulation.
- Can. H. W. Johns-Manville Co., Toronto.
- Robinson Bros. Cork Co., Toronto.

Cork Tiling.
- Robinson Bros. Cork Co., Toronto.

Cotton Hose.
- Garlock Packing Co., Hamilton, Ont.
- Quaker City Rubber Co., Philadelphia,

Couplings.
- Can. Bond Hanger & Coupling Co., Alexandria, Ont.
- Boving & Co. of Canada, Limited, Toronto.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Elmira Machinery and Transmission Co., Elmira.
- Jeffrey Manufacturing Co., Columbus.

Cranes, All Kinds.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Electric.
- Babcock & Wilcox, Montreal.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Smart-Turner Machine Co., Ltd., Hamilton.

Cranes, Hand Power.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Overhead Travelling.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Post Jib.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Swing Jib.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Wall.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Crank and Crosshead Pin Oilers
- Lunkenheimer Co., Cincinnati, O.

Crushing Machinery.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.

Cut Outs
- Duncan Electrical Co., Montreal.

Damper Regulators.
- Ed. Bemis & Co., Little Hulton, Belton, Eng.

- Darling Bros., Montreal.
- G. M. Davis Regulator Co., Chicago, Ill.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Geo. H. Tod, Toronto.

Detector Phones.
- The Maihak Indicator Agency, Montreal.

Die Stocks.
- Oster Mfg. Co., Cleveland, O.

Distilling Apparatus.
- Frick Co., Waynesboro, Franklin Co., Pa.

Doors, Cold Storage and Freezer.
- Jones Cold Store Door Co., Hagerstown, Md.

Double Pipe Condensers.
- Frick Co., Waynesboro, Franklin Co., Pa.

Dry Cleaners Systems.
- S. F. Bowser & Co., Inc., Toronto.

Drying Machinery.
- Can. Fairbanks-Morse Co., Montreal.

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- W. H. Allen Son & Co., Bedford, Eng.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Engineering Works of Canada, Ltd., Montreal.
- Siemens Co. of Canada, Ltd. Montreal.

Economizers.
- Babcock & Wilcox, Montreal.
- Can. Fairbanks-Morse Co., Montreal.

Ejectors.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Smart-Turner Machine Co., Ltd., Hamilton.

Electric Fans.
- Canadian General Electric Co., Ltd., Toronto.
- Siemens Co. of Canada, Ltd. Montreal.

Electrical Accessories and Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Canadian H. W. Johns-Manville Co., Toronto.
- Duncan Electrical Co., Montreal.
- Engineering Works of Canada, Ltd., Montreal.
- Monarch Electric Co., St. Lambert, Que.
- Northern Electric & Mfg. Co., Limited Montreal.

Electrical Repairs.
- Siemens Co. of Canada, Ltd. Montreal.

Electrical Supplies
- Duncan Electrical Co., Montreal.

Elevators.
- Engineering Works of Canada, Ltd., Montreal.
- John McDougall Caledonian Iron Wks, Montreal.

Elevating Machinery.
- Can. Fairbanks-Morse Co., Montreal.
- Engineering Works of Canada, Ltd., Montreal.
- Goldie & McCulloch Co., Galt.
- Jeffrey Manufacturing Co., Columbus.
- Waterous Engine Works Co., Brantford.
- Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
- Commercial Oil Co., Hamilton.

Engineers' Supplies.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto

Engines, Automatic and Drop Valve.
- Can. Allis-Chalmers, Ltd., Toronto.
- Frick Co., Waynesboro, Franklin Co., Pa.
- E. Leonard & Sons, London, Ont.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que
- E. Leonard & Sons, London, Ont.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
- W. H. Allen Son & Co., Bedford, Eng.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Canadian Westinghouse Co., Hamilton.
- E. Leonard & Sons, London, Ont.
- John Robson (Shipley) Ltd., Shipley, Eng.
- Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
- W. H. Allen Son & Co., Bedford, Eng.
- Boving & Co., of Canada, Limited, Toronto.
- Engineering Works of Canada, Ltd., Montreal.
- Goldie & McCulloch Co., Galt.
- Laurie & Lamb, Montreal.
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Wks, Montreal.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Works Co., Brantford.

Engines, Marine.
- W. H. Allen Son & Co., Bedford, Eng.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- E. Leonard & Sons, London, Ont.
- Laurie & Lamb, Montreal.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
- W. H. Allen Son & Co., Bedford, Eng.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que
- Laurie & Lamb, Montreal.
- E. Leonard & Sons, London, Ont.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Works Co., Brantford.
- Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
- W. H. Allen Son & Co., Bedford, Eng.
- Boving & Co., of Canada, Limited, Toronto.
- Jenckes Machine Co., Sherbrooke, Que.
- Laurie & Lamb, Montreal.
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Wks, Montreal.
- Kerr Engine Co., Walkerville.
- International Engineering Works, Ltd., Amherst, N. S.
- Waterous Engine Works Co., Brantford.

Engines, Vertical.
- W. H. Allen Son & Co., Bedford, Eng.
- Laurie & Lamb, Montreal.
- E. Leonard & Sons, London, Ont.
- International Engineering Works, Ltd., Amherst, N. S.

Engineers' Supplies.
- Lunkenheimer Co., Cincinnati, O.

Exhaust Fans.
- W. H. Allen Son & Co. Bedford, Eng.
- Hare Eng. Co., Toronto.

Exhaust Heads.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Watson & McDaniel Co., Philadelphia

Expansion Joints.
- Lunkenheimer Co., Cincinnati, O.

Feed Water Alarms.
- H. L. Peiler & Co., Montreal.

Feed Water Analyser.
- H. L. Peiler & Co., Montreal.

Feed Water Heaters.
- Alberger Condenser Co., New York.
- Babcock & Wilcox, Montreal.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- National Pipe Bending Co., New Haven, Conn.
- International Engineering Works, Ltd., Amherst, N. S.
- Nobis Engineering Co., Toronto.
- The Sims Co., Erie, Pa.
- Waterous Engine Works Co., Brantford.

Feed Water Regulators.
- Can. Allis-Chalmers, Ltd., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.

Filters.
- John McDougall Caledonian Iron Wks, Montreal.

Filters, Water.
- Frick Co., Waynesboro, Franklin Co., Pa.

Fire Hose.
- Canadian Consolidated Rubber Co., Ltd., Montreal.
- Quaker City Rubber Co., Philadelphia, Pa.
- Reddaway & Co., F., Montreal.

Fireproof Cold Store Doors and Windows.
- Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
- American Pulley Co., Philadelphia.

Flanges.
- Dart Union Co., Toronto.
- Lunkenheimer Co., Cincinnati, O.

Flumes, Steel.
- Boving & Co., of Canada, Limited, Toronto.
- E. Leonard & Sons, London, Ont.

Freezer Doors.
- Jones Cold Store Door Co., Hagerstown, Md.

Furnaces.
- Monarch Electric Co., St. Lambert,

Furnace Linings.
- Hare Eng. Co., Toronto.

Fuses.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Canadian General Electric Co., Ltd., Toronto.

Fuses, Renewable.
- Economy Fuse & Mfg. Co. of Canada, Montreal.

Gaskets, Rubber, Asbestos, Lead and Copper.
- Can. Gasket Co., Bridgeburg, Ont.
- Durabla Mfg. Co., New York.
- Frick Co., Waynesboro, Franklin Co., Pa.
- Goetze-Gasket & Packing Co., New Brunswick.
- Canadian H. W. Johns-Manville Co. Ltd., Toronto.
- Garlock Packing Co., Hamilton, Ont.

Gas Exhausters.
- Hare Eng. Co., Toronto.

Gas Producer Plants.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- E. Leonard & Sons, London, Ont.

Gasolene & Oil Storage & Distributing Systems.
- S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
- Can. Fairbanks-Morse Co., Montreal.
- Durabla Mfg. Co., New York.
- Hare Eng. Co., Toronto.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Ohio Brass Co., Mansfield, Ohio.
- W. J. Wall, Montreal.
- Garlock Packing Co., Hamilton, Ont.
- Lunkenheimer Co., Cincinnati, O.

Gauges—Pressure, Vacuum, Draft and Recording.
- Babcock & Wilcox, Montreal.
- Lunkenheimer Co., Cincinnati, O.

Gauges, Water.
- Jenkins Bros., Ltd., Montreal.
- The Lunkenheimer Co., Cincinnati, O.
- Ohio Brass Co., Mansfield, Ohio.

Gears, Cut, Worm, Mortise.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Generators.
- W. H. Allen Son & Co., Bedford, Eng.
- Siemens Co. of Canada, Ltd. Montreal.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Engineering Works of Canada, Ltd., Montreal.
- Northern Electric & Mfg. Co., Limited, Montreal.

Governors, Water Wheel
- W. H. Allen Son & Co., Bedford, Eng.

Graphite, Boiler.
- Commercial Oil Co., Hamilton.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.

Governor, Water Wheel.
- Can. Allis-Chalmers, Ltd., Toronto.

Graphitol.
- British Pacific Supply Co., Victoria, B.C.
- C. C. Snowdon, Calgary.

Grates.
- Babcock & Wilcox, Montreal.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Boiler Repair & Grate Bar Co., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Hare Eng. Co., Toronto.
- Geo. H. Tod, Toronto.

Grease Cups.
- Detroit Lubricator Co., Walkerville.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
- Can. Allis-Chalmers, Ltd., Toronto.
- Elliott Co., Pittsburgh, Pa.
- C. C. Snowdon, Calgary.
- Hare Eng. Co., Toronto.

Greases.
- British Pacific Supply Co., Victoria, B. C.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Oil Companies, Ltd., Toronto.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.

Hangers.
- Can. Bond Hanger & Coupling Co., Alexandria.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery and Transmission Co., Elmira.
- Goldie & McCulloch Co., Galt.
- Waterous Engine Works Co., Brantford.

Heaters.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- Goldie & McCulloch Co., Galt.
- Hare Eng. Co., Toronto.
- E. Leonard & Sons, London, Ont.
- The Sims Co., Erie, Pa.

Heating Engineers.
- Nolis Engineering Co., Toronto.

Hoists.
- Engineering Works of Canada, Ltd., Montreal.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.
- Nobis Engineering Co., Toronto.

Hoisting and Conveying Machinery.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
- Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
- Can. Allis-Chalmers, Ltd., Toronto.
- Smart - Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- Engineering Works of Canada, Ltd., Montreal.
- John McDougall Caledonian Iron Wks, Montreal.
- Nobis Engineering Co., Toronto.

Hydraulic Presses.
- Bawden Machine Co., Toronto.

Ice Making Machinery.
- Arctic Ice Machine Co. Canton, Ohio.
- Can. De La Vergne Co., Limited, Montreal.
- Frick Co., Waynesboro, Franklin Co., Pa.
- Linde British Refrigeration Co., Montreal.
- York Mfg. Co., York, Pa.

Insulators.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Geo. H. Tod, Toronto.

Indicators, Electric—All Types.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
- Can. Fairbanks-Morse Co., Montreal.
- The Maihak Indicator Agy., Montreal.

Indicators—Ammonia, Hydraulic.
- Detroit Lubricator Co., Walkerville.

Indicating.
- Renown Engine & Machine Co., Montreal.

Injectors.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Penberthy Injector Co., Windsor.

Iron Filler.
- Imperial Waste & Metal Co., Montreal.

Journal Greases.
- Commercial Oil Co., Hamilton.

Lace Leathers.
- Graton & Knight Mfg. Co., Worcester, Mass.

Lamps, Tungsten, etc.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Sunbeam Lamp Co., Toronto.

Lamps, Arc, Incandescent.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian Westinghouse Co., Hamilton
- P. H. Klein, Jr., Co., Montreal.
- Northern Electric & Mfg. Co., Limited, Montreal.

Lubricants.
- British Pacific Supply Co., Victoria.
- Can. Oil Companies, Ltd., Toronto.
- Jos. Dixon Crucible Co., Jersey City
- C. C. Snowdon, Calgary.
- Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
- Darling Bros., Montreal.
- Can. Detroit Lubricator Co., Windsor,
- Lunkenheimer Co., Cincinnati, O.
- Manzel Bros. Co., Buffalo, N.Y.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
- Can. Detroit Lubricator Co., Windsor, Ont.
- Lunkenheimer Co., Cincinnati, O.

Mechanical Stokers.
- Babcock & Wilcox, Montreal.
- Ed. Bemis & Co., Little Hulton, Bolton, Eng.
- Hare Eng. Co., Toronto.
- Jones Underfeed Stoker Co., Toronto.
- Murphy Iron Works, Detroit, Mich.
- Geo. H. Tod, Toronto.

Metal Spools.
- American Pulley Co., Philadelphia.

Meters, Electric.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Monarch Electric Co., St. Lambert, Que.
- Siemens Co. of Canada, Ltd. Montreal.

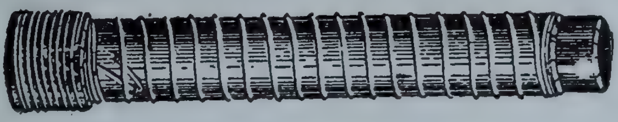
Metres, Steam.
- Nobis Engineering Co., Toronto.

Meters, Water.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Siemens Co. of Canada, Ltd. Montreal.

Mica.
- Kent Brothers, Kingston, Ont.

Mill Supplies.
- Andrews & Son, F. H., Quebec.
- Reddaway & Co., F., Montreal.

Mill and Mining Machinery.
- W. H. Allen Son & Co., Bedford, Eng.



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It is easily installed, and when in operation is easily controlled.

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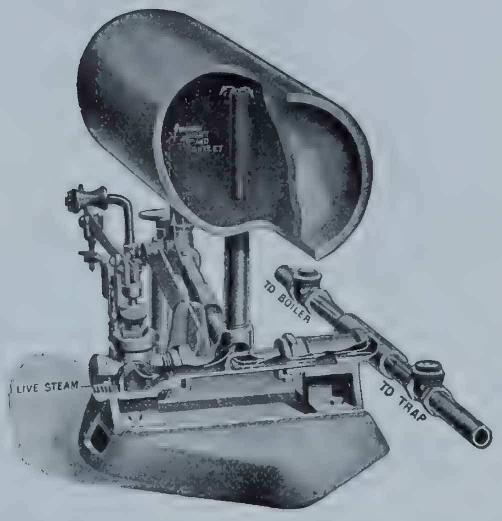
Morehead ~~Back to Boiler~~ SYSTEM



Conserve the Heat

that's in your condensation, the heat that costs you good dollars to put it there. Wasting it is equivalent to wasting money, and when you have to let your condensation cool down before your pumps can handle it back to the boiler, you're wasting heat — you're throwing money away.

Put in a "Morehead" Trap and let it return your condensation just as hot as it comes from the lines, let it conserve the heat and return it to your boilers —where it belongs—let it save you many dollars and give you a better, more efficient method of handling your condensation.

That it will do this we're willing to show you. You don't have to take our say so for it. Send us the word and we'll ship the trap and send a man with the necessary apparatus to prove our claims. And it costs you nothing unless you're satisfied.

Write to-day.

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Engineering Works of Canada, Ltd., Montreal.
Jenckes Machine Co. Sherbrooke, Que
International Engineering Works, Ltd., Amherst, N. S.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
Bawden Machine Co., Toronto.

Motors.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Motor Starters and Controllers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
S. F. Bowser & Co., Inc., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
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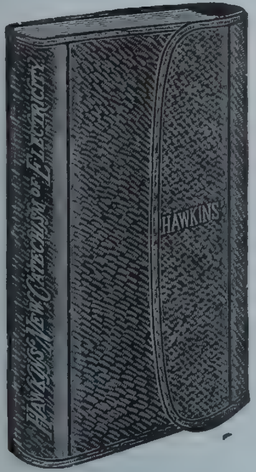

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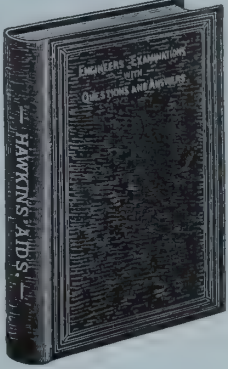

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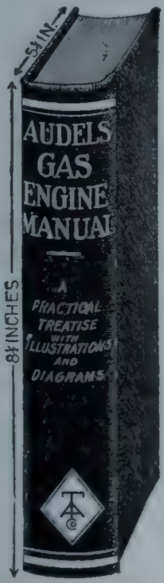

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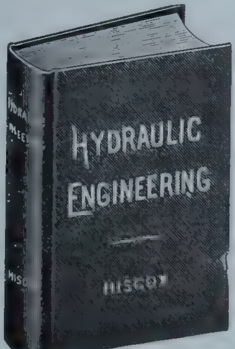

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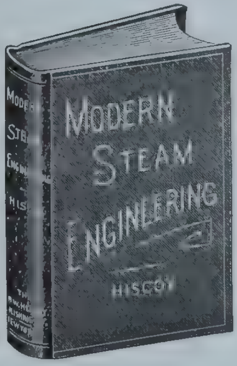

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Water Motors.
Elliott Co., Pittsburgh, Pa.

Water Purifiers, Softeners.
Babcock & Wilcox, Montreal.
Nobis Engineering Co., Toronto.

Water Wheels.
Chas. Barber & Sons, Meaford, Ont.
John McDougall Caledonian Iron Wks. Montreal.
William Hamilton Co., Ltd., Peterborough.

Whistles, Plain or Chime.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Wire, Bare and Insulated.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wire, Magnet and Trolley.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.

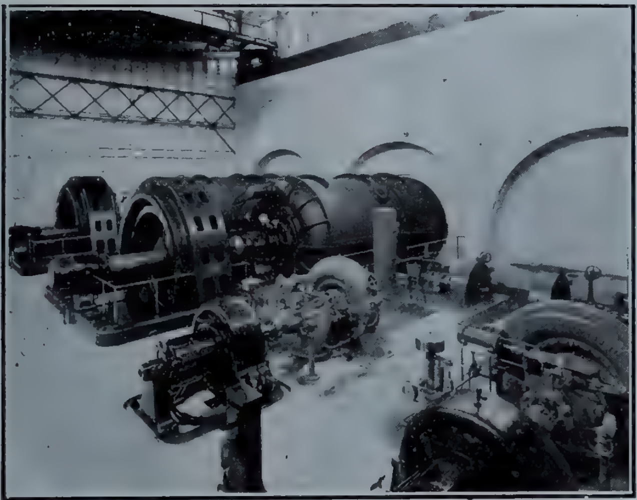
Wire, Railway Feeder and Trolley.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wrenches.
Greene, Tweed & Co., New York.

John Wanamaker says that advertising doesn't jerk — it PULLS. He ought to know, and yet some men think that advertising should go against all rules and precedents and jerk them to success with one tremendous yank.

ESCHER-WYSS & CO.

ENGINEERS

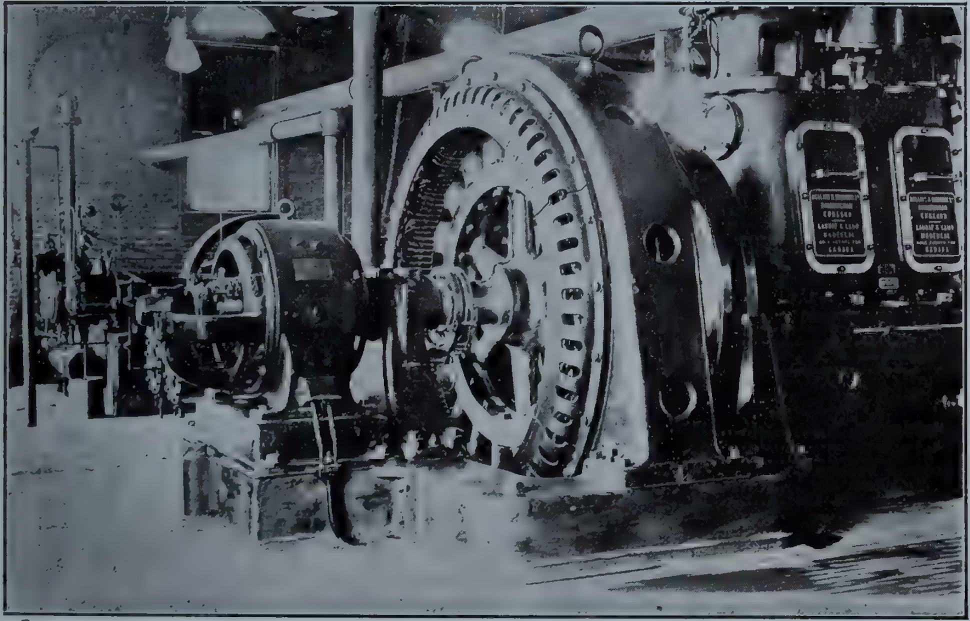


52,000 H.P. Plant Western Canada Power Co.

HYDRAULIC
STEAM **PLANTS**
PUMPING

HEAD OFFICE FOR CANADA:
626 Coristine Bldg.,
MONTREAL, Que.

High - Class Swedish Electrical Equipment

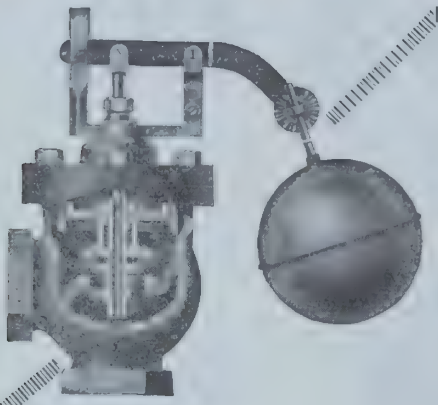


Owing to liberal design and the use of the best grade of Swedish Steel and Iron, we are able to guarantee and obtain the very best results.

350 K.V.A. 2200 Volt, 2 Phase, 60 Cycle, 360 R.P.M., AC. Generator connected to Belliss & Morcom HighS-peed Engine, supplied to Corporation of Wetaskiwin, Alta.

SWEDISH GENERAL ELECTRIC, Limited
Head Office: TORONTO **Branch Office: MONTREAL**

A Good Float Valve to Own



A PISTON, operating in a cylinder, that is packed with a leather crimp to prevent leakage is not a desirable construction for an automatic float valve. The packing causes friction and is short-lived. That means unsatisfactory operation and expensive maintenance.

The Davis Improved Float Valve

has an inner valve that is not packed in any way. It is operated entirely by pressure. The top member fits the cylinder loosely, so the inlet pressure can leak by and accumulate above the valve. The stem, which is directly attached to the float, forms an auxiliary valve that controls the action of the disc.

This valve makes an ideal automatic control for your water supply. It will always work properly without sticking. Its maximum cost for maintenance will be the few cents that you may have to spend sometime for a new renewable Jenkins type of disc. Let us send you a descriptive folder and quote on the float valves you need at this time.

— it will not stick,
— will not leak,
— has renewable disc and seat,
— has no leather cup packing,
— is operated entirely by pressure,
— has full pipe area,
— is strong and well proportioned,
— may be used as Balanced Valve,
— is made in globe and angle patterns.

G. M. Davis Regulator Co.
Established 1875
434 Milwaukee Ave. **Chicago**
New York **Pittsburgh** **St. Louis**
Philadelphia **Boston** **San Francisco**

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Reduce Your Power Expense

WITH

Westinghouse Synchronous Motors

IN SOME applications, direct-connected Westinghouse Self-Starting Synchronous Motors have actually paid for themselves in a few years by the reduction they made in the power bills.

How is this done? These motors will raise your power factor. This means, if you generate your own power, directly increasing the capacity of your present generators, transformers and transmission lines; improving the voltage regulation, and raising the efficiency of your entire power installation.

Many central stations give better rates for high power-factor installations than for low ones.

Then, too, these motors require the least floor space, cost less to install than other types, and have the highest efficiency.

Canadian Westinghouse Co., Ltd., Hamilton, Ontario

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Traders Bank Bldg.

MONTREAL
52 Victoria Square

OTTAWA
Ahearn & Soper, Ltd.

HALIFAX
Telephone Bldg.

WINNIPEG
158 Portage Ave. E.

CALGARY
Grain Exchange Bldg.

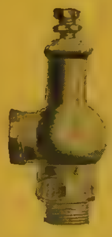
VANCOUVER
Bank of Ottawa Bldg.

Boiler Mountings, Engine Supplies, Steam Specialties,

ETC.

Genuine
Hancock Inspirator.

Oil Cup—Quick
Stop, Sight Feed



Relief Valve.

Gauge Cock.

J. M. T. INJECTOR.
(Improved)

Our lines are guaranteed to be of the highest quality.

We have been serving many large concerns for years. Let us furnish your requirements.

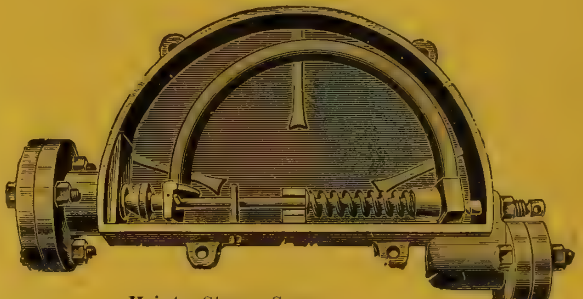
We shall be pleased to submit data or price upon anything in our line.

Our goods are approved by the Boards of Steam Boiler Inspectors.

J. M. T. Globe Valve
Renewable Disc.

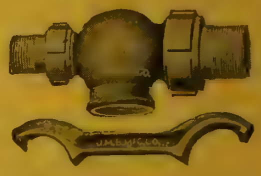
J. M. T.
SWING CHECK VALVES
Adjustable lift.

Steam and Oil Separator.



Heintz Steam Saver.

The "Heintz" device will automatically control the condensation from Dry Kiln Coils or other Heaters, keeping them entirely free of water without loss of steam. They are very simple in construction and operation and can be placed in any convenient location.



"Gem" Ejector.

The James Morrison Brass Mfg. Company, Ltd.

93-97 Adelaide St. West - TORONTO

Special Feature—Articles on Refrigeration

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.
MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. VII. Publication Office, Toronto—February, 1914 No. 2

TRADE PENBERTHY MARK

"ALL QUALITY LINE"

REGRINDING BRASS VALVES

Exterior View

Compare our prices with what you have been paying for valves not so High Grade.

Why not get "the best for less"?

Reduce Your Repair Bills

and

Increase Your Plant Efficiency

by installing

This High-Grade Valve in Your Steam Plant.

The Finest Valve on the Market

Design—Quality—Workmanship—Finish Unequalled

The Governments of
ONTARIO, ALBERTA and SASKATCHEWAN
(Departments of Public Works)

Have approved and registered this high-grade line of PENBERTHY All Quality Regrinding Brass Valves as suitable for steam pressures as high as 200 lbs.

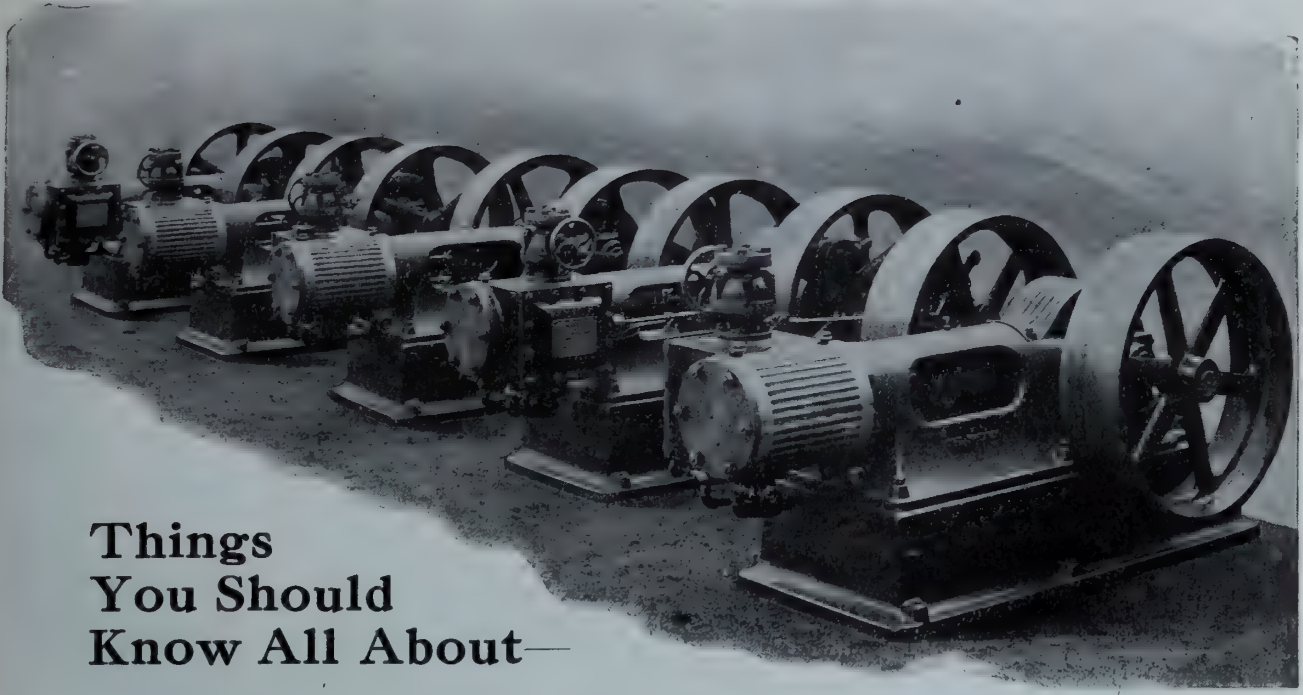
Write for interesting booklet, "Something Better in Valves." It's free to you.

Penberthy Injector Co., Limited
Windsor, Ont.

RAINBOW PACKING
IS USED IN THE FOUR CORNERS
OF THE GLOBE

MANUFACTURED EXCLUSIVELY BY
PEERLESS RUBBER MANUFACTURING COMPANY
16 WARREN ST., NEW YORK.

FOR SALE EVERYWHERE



Things You Should Know All About—

WHEN buying an engine there are some things you should insist on knowing:—that the engine you select is adapted to your work—that it has the capacity to stand up continuously to it—and that if anything does go wrong, the engine you have bought is backed up by a firm that will see that the damage is made good.

McEWEN ENGINES

are, first of all, sold on a basis of *satisfaction to the user.*

They are High-Speed Automatic Engines of the best type, built to stand up to hard usage. You will find few other engines giving the results you can get with the McEwen when it comes to delivering power, saving steam, and standing up to the work under a varying load. Furthermore, unless we are convinced that the McEwen will do your work—and *do it better than another engine,*—we will not advise you to buy.

We back up every McEwen we sell with a rock-bottom guarantee that covers performance and service, and although we have sold hundreds of these engines we have never yet been asked to redeem the guarantee. The engines are built to make it unnecessary.

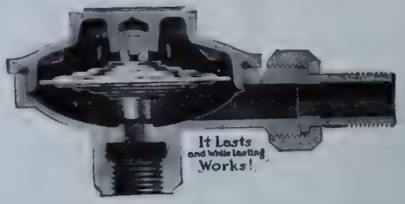
The McEwen Booklet is worth while—send for it.

The Waterous Engine Works Co., Ltd.

BRANTFORD, CANADA

GOOD and BAD HEATING

The heating season is now about half over. Will you kindly answer these questions (to yourself)?



Performs the functions of a Radiator Steam Trap perfectly and continuously. Eliminates water and air without loss of steam.

Have you had an item of expenses in labor and repairs for fixing traps that might have been saved?

Have you had any freeze-ups due to traps stopping up or traps leaking so much steam that the vacuum pump could not draw the water of condensation back properly and some return line froze up?

Have you had to admit cold water into the returns of the vacuum pump to condense steam that has wasted past the radiator traps?

If you have a gravity system of heating:—

Have you had to carry pounds steams pressure to secure circulation through your radiators?

Have you had to spend a great deal of time adjusting those spitting, sputtering air valves which either blow steam or water or keep the air in the radiator?

These will remind you of only a few troubles you may have experienced with your heating system.

Have you ever investigated the Dunham System, particularly the Dunham Traps?
Do you know that the Dunham Trap makes it possible to overcome all of these troubles?
Do you know that the Dunham Trap insures positive circulation of steam at a very low pressure?
Do you know that you can secure a Dunham Trap for sixty days' free trial, to convince yourself of our claims and if not satisfactory can be returned to us and not cost you one cent?

Well You Can! Write us for particulars of our "Try-Out Plan."

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

Halifax Montreal Winnipeg Vancouver Calgary Ft. William

Frost King Babbitt Metal

Is the result of 35 YEARS' EXPERIENCE in metal mixing and we believe it is absolutely perfect.

For high-speed machinery and engine work it is without an equal. It is specially designed for Saw Mills, Planing Mills, Threshing Engines, Traction Engines, Pumps, Rolling Mills, and Pulp Machinery, and all classes of stationary engines.

If your dealer does not stock "FROST KING" write us and we will take pleasure in making you a shipment of a 25-pound box.

OUR MIXED METAL SALES AMOUNT TO $5,000,000 ANNUALLY.

Hoyt Metal Company, Toronto, Ont.

FACTORY AND OFFICE :—Eastern Avenue and Lewis Street

New York, N.Y. London, Eng. St. Louis, Mo.

JENCKES BOILERS

Serve
Efficiently
& Economically

HORIZONTAL TUBULAR

VERTICAL TUBULAR

HEATING BOILERS

LOCOMOTIVE TYPES

Whatever is best in material, whatever is best in manufacturing methods—that is the spirit which symbolizes Jenckes Boiler Construction. No expense or trouble is spared to produce boilers that will be the equal of any, and that will give in service, unfailing satisfaction.

They're made in compliance with the different Provincial requirements.

Write for Catalog.

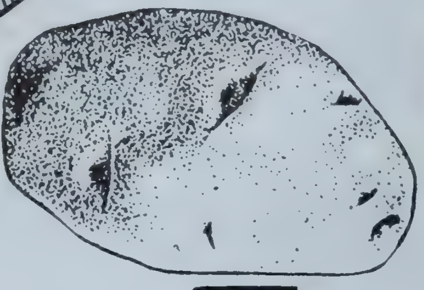
The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Toronto Cobalt
South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE.
ST. CATHARINES, ONT.

Toronto Office: 309 Confederation Life Building.

POTATO SCALE



BOILER CLEANSER

Would you feed your boilers on dollar bills? Would you order your firemen to fill up the stoker hoppers with nice, clean "greenbacks" fresh from the bank?

Of course you wouldn't!

You'd know that a dollar will purchase a great deal more calorific value in coal than it will give as feed under a boiler.

You wouldn't do this—you're a sane business man—yet you allow your boilers to accumulate scale that effectually prevents all but a small percentage of the heat you get out of your coal, from reaching the water it's intended for.

And you grouch at the cost, and go on "feeding with dollar bills."

Potato Scale Boiler Cleanser goes right to the root of this scale trouble—the feed water. Fed into your boilers in the manner and quantity we prescribe, it will quickly clean tubes and sheets of all adhering scale. And its continued use will prevent any new scale forming.

Send for a keg now. We guarantee it.

But do it now. Dollar bills aren't so very plentiful.

We sell 4 kinds of BOILER GRAPHITE
Get our prices.

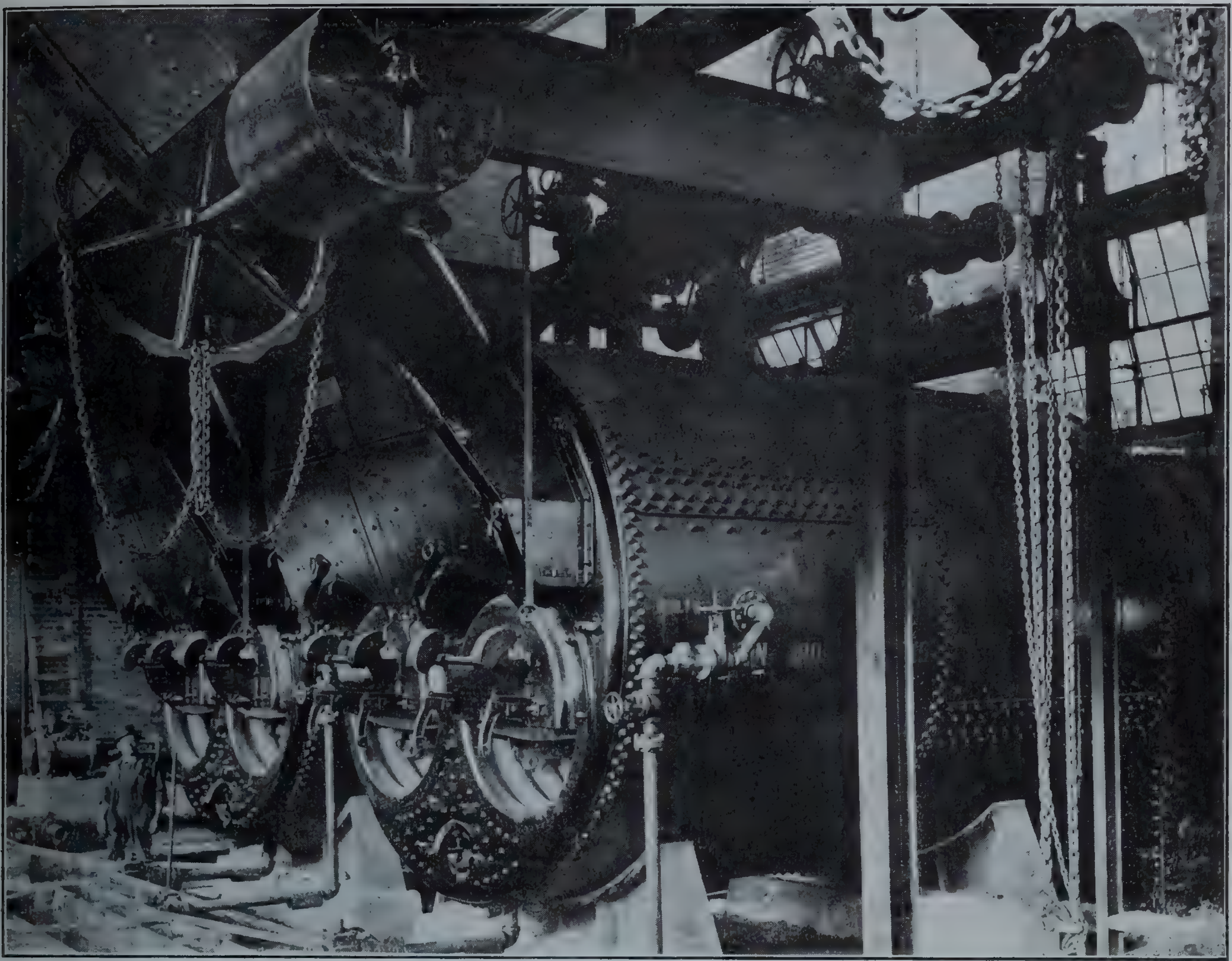
C. C. SNOWDON

1810 - 1840 11th STREET EAST, CALGARY, ALBERTA
P.O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches :— Edmonton Winnipeg Vancouver



REPEAT ORDERS TESTIFY

to the reputation that "**Polson**" **Boilers** have gained for correctness of design, construction and general all-round efficiency; to the number of satisfied users who are content to put their steam-raising problems up to the Polson Iron Works; to the high esteem in which they are held by engineers all over the country.

These two boilers were built to fill a repeat order from the Consumers' Gas Company, Toronto. They are of the return-tubular dry back type, each 11 ft. 6 inches diameter, and 15 ft. long. They are fitted with Morrison Furnaces and Adamson Furnaces with Galloway Tubes.

How about your boiler problems? We can give you the same service.

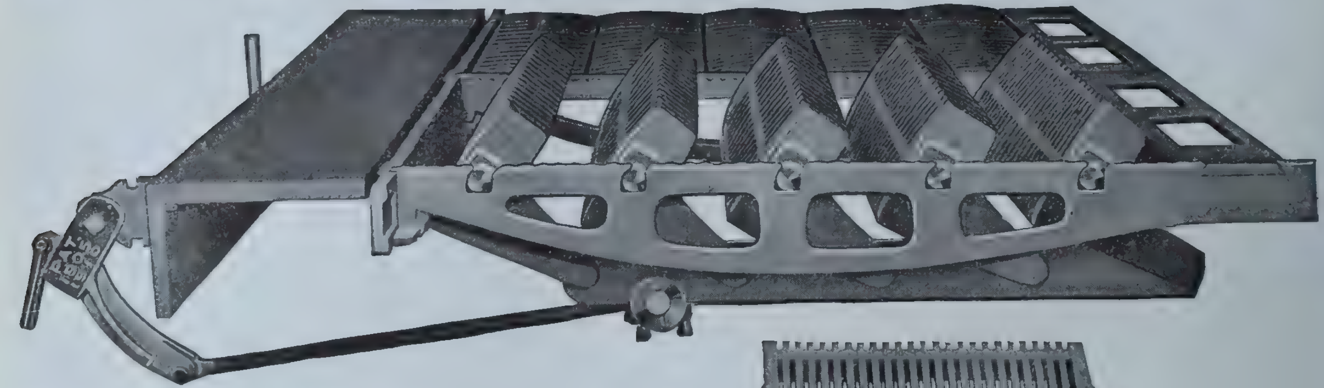
Polson Iron Works, Limited

Toronto, Ontario

Representatives in Canada for

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, Eng., Marine Motors

“The Cyclone” Shaking and Dumping Grate Bar



Cleaning Fires!

Raking red-hot clinkers from the mouth of a roaring furnace.

The smoke—the suffocating fumes—the sizzle and the hot sting of steam as you throw water on them.

That sort of thing's hard work—takes it out of you, makes you feel more dead than alive at the end of the day.

And as the "Cyclone" Grate will give you better steam and allow you to shake the clinkers through into the ash-pit by just pulling a lever—it's absolutely unnecessary exertion.

To shake the fire so gently that you just settle the uneven places; to shake it so vigorously that you clear all the clinkers out; to dump the whole fire into the ash-pit, you can do it all on the "Cyclone" by just pulling the lever.

And the patented lock prevents the bars from moving unless you do pull the lever.

Ask any of its users what they think about it. We're ready with the address as soon as you say the word.

The Canadian Steam Boiler Equipment Co., Limited

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: TORONTO, CANADA

AGENTS

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

The advertiser would like to know where you saw his advertisement—tell him.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL

THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS— PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA **TORONTO** **WINNIPEG**

THOMAS GRATE BAR CO., **Birmingham, Ala., U.S.A.**

Stop Blow-outs and Leaks in Pipe Lines by Using

GOETZE No. 2 ELASTIC GASKETS

If you start right now to renew with No. 2 ELASTIC GASKETS, you can steadily reduce your renewals until you have brought them almost to the vanishing point.

This is not a mere "claim"—it is backed up by a *guarantee*—in fact the strongest guarantee ever made by a gasket manufacturer.

Think what it means to re-gasket a joint so it will *keep tight for years,* instead of days or weeks. Think of the saving resulting in gasket costs, labor and shut-downs.

What No. 2 Elastic Gaskets Will Do

No. 2 Elastic Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight. Prevent leaks, blow outs and shut-downs. Will practically eliminate renewal expense for gaskets.

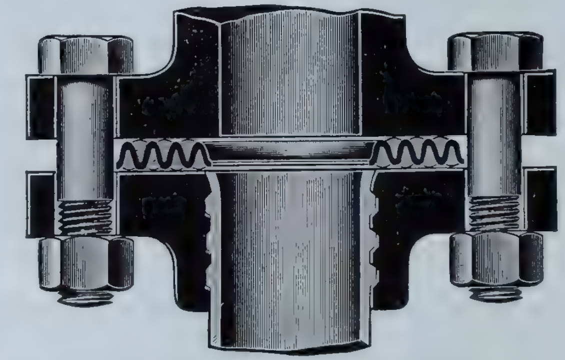
No. 2 Elastic Gaskets are for high pressure and super-heated steam lines, but owing to their indestructible nature, are equally adapted to *any and every condition* about a factory, mill or refinery.

The No. 2 Elastic Guaranteed

Every No. 2 Elastic Gasket is Guaranteed for 5 Years' Continual Service in the Same Joint

There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every No. 2 Gasket whether bought direct from us or through a dealer.

How No. 2 Elastic Gaskets are Made



These Gaskets are made of corrugated copper with asbestos lining No. 2. The corrugations allow for expansion and contraction of the pipes, while the asbestos, being forced into the pores of the metals in the flanged surface by the "squeeze" and the constant pressure of the corrugations beneath it, holds securely against the highest pressures.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

ST. JOHN, N.B.

BRANCHES AT

MONTREAL	TORONTO	WINNIPEG	LETHBRIDGE, Alta.	VANCOUVER
112 St. Peter St.	Mills Bros., 809 Lumsden Bldg	C. E. Chown, 425 Henry Ave.	J. B. Turney & Co.	c/o A. O. Campbell, 626 Pender St.

MANUFACTURED BY

Goetze Gasket & Packing Co., New Brunswick, N.J.

TESTED PACKINGS

FOR EVERY PURPOSE

THIS PAMPHLET is an authentic text-book—a complete illustrated guide—to standard lines of tested packings.

We shall be glad to send you a copy, gratis.

Canadian Consolidated Rubber Co., Limited
MONTREAL

Please use this coupon ☛

Canadian
Consolidated
Rubber Co., Limited
Montreal

Gentlemen:

Please send me a complimentary copy of "Tested Packings for Every Purpose."

Name ....

Address ....

....

Cheaper than P.P.P.
My Packing Looks like P.P.P.
This Packing Has Sliding Wedges like P.P.P.
The Packing That Prevents Some Friction.
DANIEL'S P.P.P.

Everybody's Doin' It

The best recommendations for an article are the number of imitations offered and the nearness (in appearance) of the imitations to the genuine, of course, making allowance for legal bars to making exact copies.

Another point, an ordinary or second-rate article is never imitated; the reason is that it takes the high reputation of the BEST to create a market for the "just-as-good" or "cheaper-than" kinds. The next step is to copy the advertising of the GENUINE article or, at least, to CLAIM for the counterfeits, results that the REAL actually give.

DANIEL'S ROD PACKING

P. P. P.

COIL, SPIRAL, RING

P. P. P. was the FIRST "sliding-wedge" rod packing. It has been on the market for TWENTY YEARS.

P. P. P. was the FIRST rod packing designed to PREVENT unnecessary FRICTION.

P. P. P. was the FIRST rod packing whose ADVERTISING laid stress on the relation of packing to FRICTION. And, until within a year or so, was about the ONLY advertising which covered this point.

P. P. P. was the FIRST and (to our knowledge) is the ONLY rod packing whose claims are backed with SCIENTIFIC PROOF.

The P. P. P. "Red Book" ("The Story of Some Friction Tests") was the FIRST book to go into the question of rod friction, and it is the text-book from which much of the material has been secured to advertise imitations of the ORIGINAL "sliding-wedge" packing.

A little time devoted to the study of our RED BOOK will make you a Packing EXPERT; give you a better theoretical and practical knowledge of the relation of various types of packing to FRICTION than is possessed by most college-graduate Mechanical Engineers. Size 5 x 7 inches, 44 pages, 12 diagrams, indicator cards, etc.; 35 illustrations, bound in red. More than 100,000 copies have been issued. It is FREE, if you ask for "Book 24-B." Write TO-DAY.

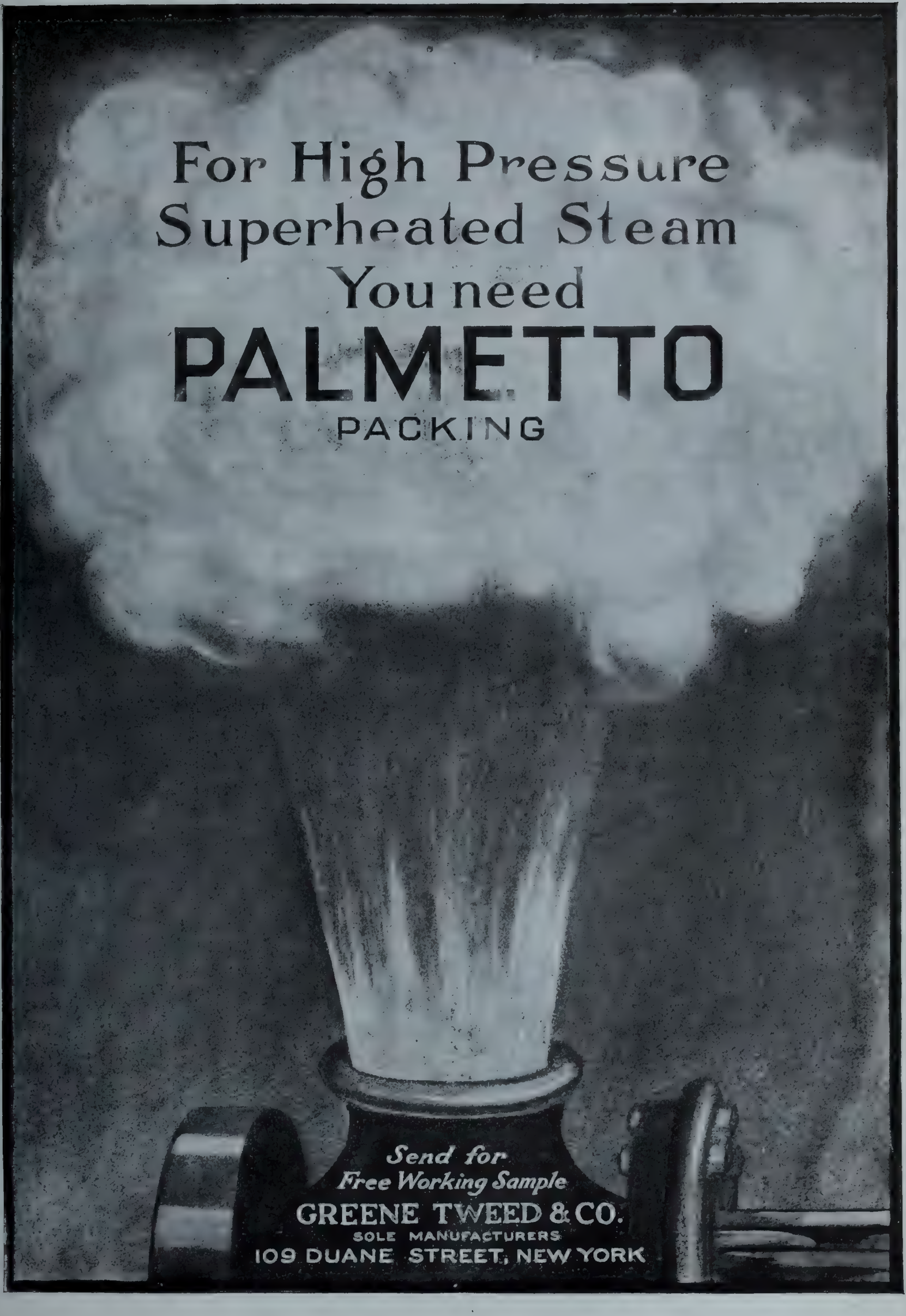
Insist on getting the box with the big RED D (see illustration) and the signature of C. A. Daniel.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.

629 Market St.



For High Pressure
Superheated Steam
You need
PALMETTO
PACKING

*Send for
Free Working Sample*

GREENE TWEED & CO.
SOLE MANUFACTURERS
109 DUANE STREET, NEW YORK

Ever Shut Down on Account of a Burned-out Bearing?

A BOWSER
Lubricating System Would Prevent This

If so, there is something to be remedied in your power plant.

Putting up with "out-of-date" oiling systems in your engine room in this day and age of progress is a big mistake.

It means that you and your stockholders are depriving yourselves of a Necessity that most of your competitors are enjoying.

For you can buy a small oiling system, intended for use in small plants which have comparatively small amounts of oil drips to handle.

Or, the highest grade oil filtering and circulating system for the largest power plant, at a price that you will save in a year out of what is now dead loss.

We have supplied oiling systems that pay 100% dividends in many plants, ranging from 50 H. P. up to 500 H. P. or more, in fact, wherever two gallons or more of oil per day are used.

A Bowser Filtering System is a Necessity

An oiling system that will reduce friction 5% will effect savings in one year's time sufficient to pay the entire cost of the installation, and if run 24 hours a day it will effect even more.

For example:—A list of savings are here tabulated, using a sample plant as an illustration:—

Three 500-kilowatt engines, run 20 hours per day, average, full load, 12 hours, 300 days per year. Coal consumption, 10 pounds per kilowatt hour. Coal cost, per ton, $1.80. Unloading, firing, cleaning ashes, cleaning boilers, etc., 40c per ton.

What our systems save for the large plant they will show in proportion in the small plant. No matter whether you use two gallons or two hundred or more gallons of oil, write now for descriptive literature of the

Bowser Safe Oil-Filtering Systems

Installed, it assures every member of your power plant a 365-day guarantee of freedom from worry, and at the same time increases your output and dividends.

Remember the name

BOWSER
ESTABLISHED 1885

stamped on the system, guarantees Service, Confidence and the Knowledge that 28 years of experience are incorporated in every system. You can install the outfit yourself from our blue prints and from our simple directions accompanied by the blue prints, or we will install for you, thus relieving you of every care.

Coal cost per year:		
27,000 tons at $1.80	$49,600.00	
Coal handling at 40c per ton	10,800.00	
	$60,400.00	
5% frictional savings		$ 3,020.00
24 barrels at 40 gal. at 40c..	480.00	
6 barrels with system at 50 gal. at 15c	45.00	
Oil Saving		435.00
Repairs to journals ....$	100.00	
Repairs with system, 20%..	20.00	
Saving in repairs		80.00
Shut downs, loss of labor, materials and profit		75.00

Valve of engines, etc., that would be lost when worn out	$100,000.00	
Life by hand feed, 25 years..	4,000.00	
Per year depreciation; life by stream feed 40 years, or per year	2,500.00	
Yearly saving in depreciation........		$1,500.00
20% of the time of oilers utilized for useful work, $1,200.00 x 20%..		240.00
Savings, occasioned by removing vibration to foundations, piping, etc., disregarded		000.00
Total savings		$5,350.00
Cost of a Bowser System to effect these economies, including necessary oil guards, cups, piping and installation		$2,675.00

S. F. BOWSER & CO., Inc.

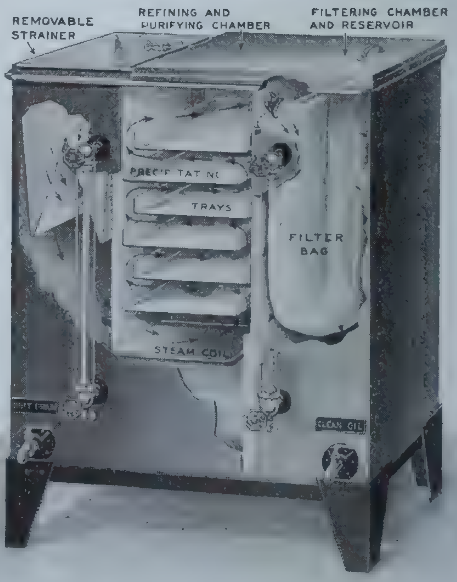
Engineers and Manufacturers of Oil-Handling Devices

66-68 FRAZER AVE., TORONTO, ONT., CAN.

Made by Canadian Workmen and Sold by Canadian Salesmen.

Sales Offices in all Centres and Representatives Everywhere

Original patentees and manufacturers of standard self-measuring hand and power driven pumps, large and small tanks, gasolene and oil storage and distributing systems, self-registering pipe line measures, oil filtering and circulating systems, dry cleaner's systems, etc.



BOWSER 7F SYSTEM
Collects and cleans the drips ready to be used again. Rated capacity—5 to 275 gallons, per day.

When You Order

HIGH PRESSURE JOINTING

Specify

GARLOCK HOLDTITE

Because,

"Holdtite" will stand a varying temperature up to 572° Fahr. Has a tensile strength of 3 tons per square inch and stands a comprehensive strain of 14 tons and still retains it elasticity.

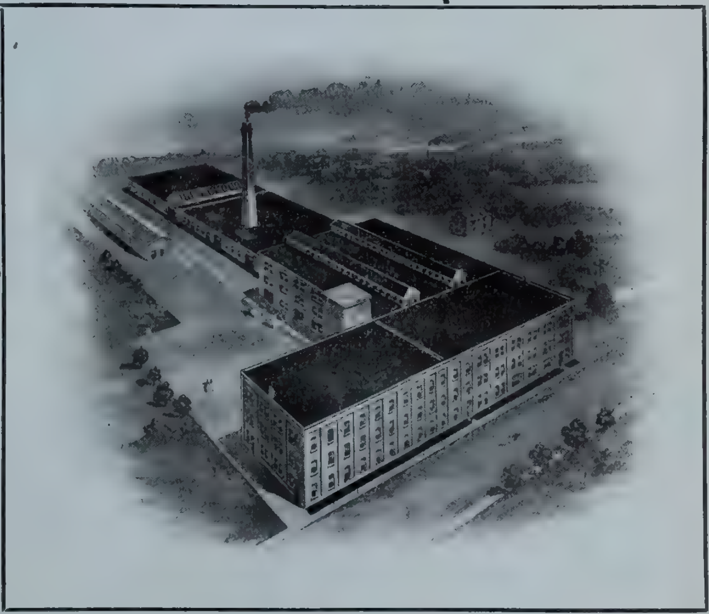
Put up in Sheets 40-in. x 40-in. in 1-32-in., 1-16-in., 1-8-in.

Write for sample and interesting information.

THE GARLOCK PACKING CO.
HAMILTON, ONT.

Montreal Toronto Winnipeg Calgary

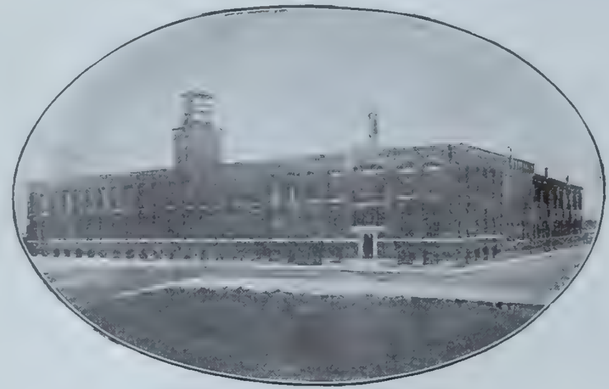
"Pioneers in the Packing Business — and Specialists"



Works at Hamilton

JENKINS BROS.'

FACTORY AT MONTREAL, CANADA



TYPE "K"

GATE VALVES

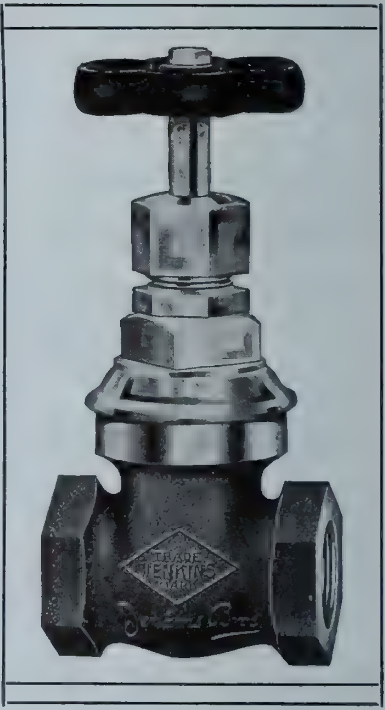
FOR

STEAM, WATER, GAS, OIL or AIR

THE PRODUCT OF ONE OF THE
MOST UP-TO-DATE VALVE
FACTORIES IN THE WORLD

SPECIAL FEATURES:

HIGHEST QUALITY STEAM METAL
PERFECT INTERCHANGEABILITY
DOUBLE COMPENSATING BRONZE WEDGES
STUFFING-BOXES Packed with ASBESTOS RINGS
METAL GLANDS IN STUFFING-BOXES
GREAT STRENGTH OF ALL PARTS
EVERY VALVE CAREFULLY TESTED
UNEQUALLED IN DESIGN AND WORKMANSHIP



Our Diamond Trade-Mark, as shown on cut, is cast on the body of all Genuine Valves.

See that the Valves you buy bear it.

STOCKED BY DEALERS
EVERYWHERE

CATALOGUE MAILED FREE UPON REQUEST

JENKINS BROS., Limited

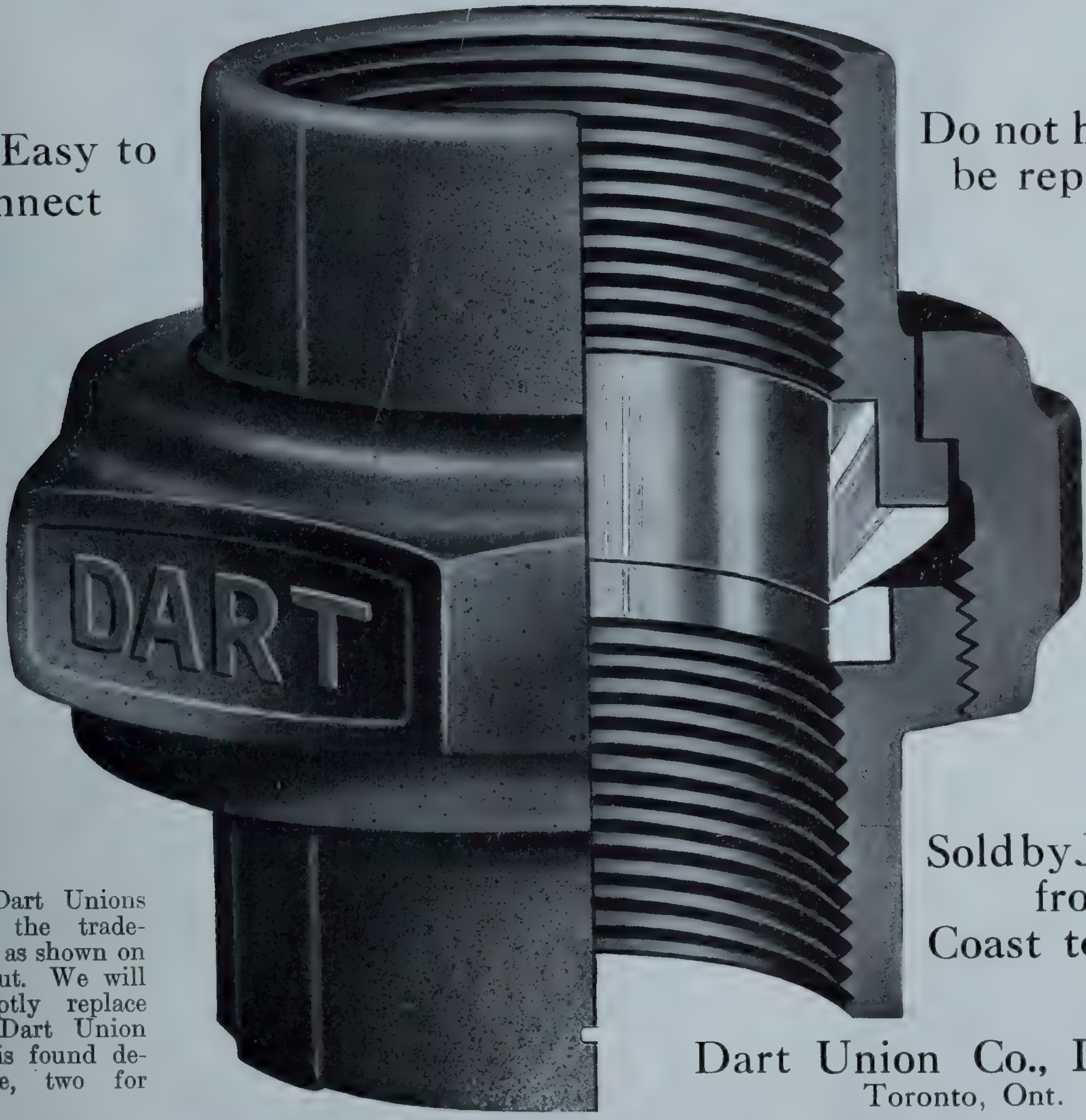
103 St. Remi Street **MONTREAL**

DART UNIONS

Make Pipe Connections That STAY Tight

Very Easy to
Connect

Do not have to
be replaced

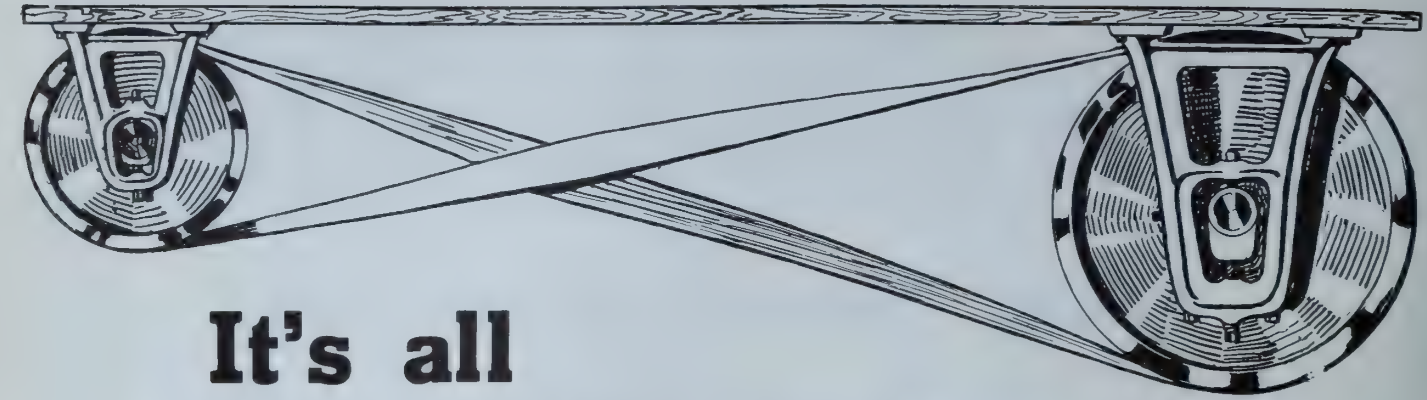


All Dart Unions have the trade-mark as shown on the cut. We will promptly replace any Dart Union that is found defective, two for one.

Sold by Jobbers
from
Coast to Coast

Dart Union Co., Limited
Toronto, Ont.

BRONZE TO BRONZE AT THE JOINT
CANNOT RUST OR CORRODE



It's all in the Leather !

Running round a twelve-inch pulley, revolving at 300 revolutions a minute, means that every part of the belt is folded up and straightened out 18,000 times an hour.

And this is the reason that belts made of inferior parts of the hide, or of leather tanned by a process that destroys its animal elasticity, will not stand up to this gruelling service without quickly showing signs of distress.

Modern science has not been able to devise any quick method of tanning leather, which will yield a product comparable with that obtained by the old, slow British oak-tanning process—which will produce a leather, thoroughly tanned, yet retaining all the "life" of the original rawhide.

Therefore on your most difficult drives put

D. K. McLAREN'S

Genuine British Oak-Tanned

LEATHER BELTING

every foot of which is guaranteed made from a selected part of the hide, tanned by the only process that retains all its life.

No necks, bellies, or shoulders are allowed to enter into the composition of D. K. Maclaren's belting. The very finest part of the hide only is used, all the rest being discarded.

And before we make it up into belts we thoroughly stretch every inch of it—so in service they will transmit the maximum of power, with a minimum of slip, and will require tightening very seldom.

Let us put you in touch with a few out of many satisfied users—and be guided solely by what they tell you.

We **know** what the result will be,—**so write us now.**

This mark on a belt is a guarantee of the sort of belt-service you want.

D. K. McLAREN Limited

Montreal
351 St. James St.

Toronto
200 King St. W.

Vancouver
37 Alexander St.

St. John, N.B.
64 Prince William St.

Educational Talks On Leather Belting by the

GRATON & KNIGHT MFG. COMPANY

WORCESTER, MASSACHUSETTS

To attain maximum efficiency and economy in your plant it is absolutely essential to know all possible about belting.

Leather Belting correctly installed and properly cared for is the most efficient and economical transmission medium.

Yet it is a well known fact that belting receives very little attention for such an important factor. For this reason we intend to publish in this paper a series of educational talks on belting, its selection, its care, etc. They will be "straight from the shoulder" talks, plain, instructive and authoritative.

Our Engineering Department is at your service, consult it freely concerning your transmission problems.

1851 G&K

Subject for Next Month:

"What Constitutes Good Leather Belting."

Where Only "Efficiency Belts" are Manufactured

G&K
GRATON & KNIGHT MFG CO. OAK LEATHER TANNERS AND BELT MAKERS

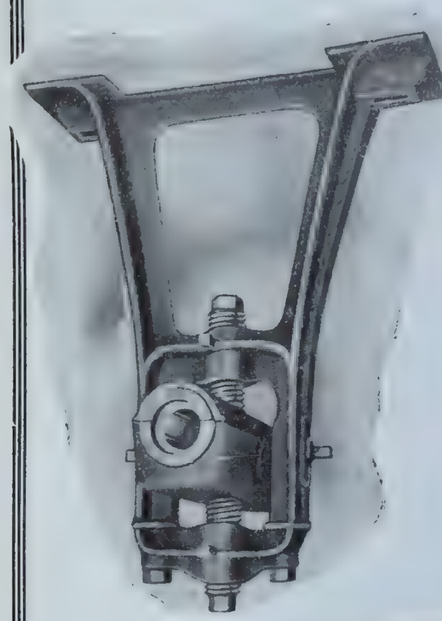
ELMIRA

Ball & Socket HANGERS

For MAXIMUM Service

Wood Split PULLEY

AND BIG REDUCTION IN POWER TRANSMISSION COST



The "Elmira" Ball and Socket Hanger

is exceptionally strong and heavy. In this hanger a union system of oiling is employed, a combination of centrifugal and capillary attraction, effected by tempered steel rings and woven cotton distribution of lubricant, and precludes the slightest possibility of "Dry Bearings" so long as any oil remains in the reservoir or dry chamber, one filling of which should last from six to twelve months.

The "Elmira" Wood Split Pulley

You can use an "Elmira" Pulley any place that a leather belt will give satisfaction, and know that what any good pulley will do, it will do, and more.

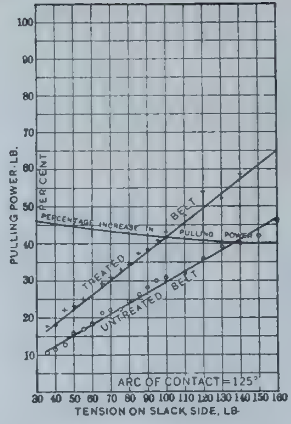
This pulley stands the hardest and most severe conditions. It is nailed throughout. The arms are tenoned into rim and dowelled there.

Absolutely guaranteed.

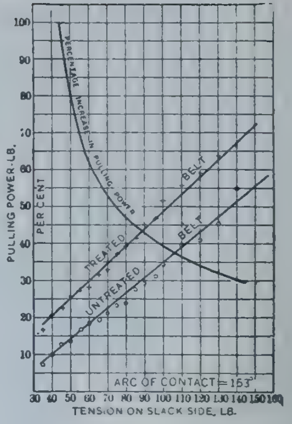
It will be much to your interest to let us furnish you with our illustrated catalog. Write for it to-day.

Large and complete stocks carried at Elmira and by The A. M. Ellicott Co., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Ltd.
ELMIRA, CANADA



40 to 46 per cent. increase.



30 to 100 per cent increase.

These Curves Show the Increased Pulling Power Produced by Cling-Surface.

And as they were plotted by Robert Thurston Kent, M.E., you can know they are authoritative.

Mr. Kent tested two new belts—one treated with Cling-Surface, and the other not. To make the test perfectly fair, both belts were first driven side by side in a New Jersey factory. Then, by means of a testing frame built especially for the purpose, some weights, and a polished rigid pulley, the comparative tests indicated by these curves were made.

Note that no matter how large or how small the arc of pulley contact and no matter what the tension on the slack side, the Cling-Surface curve is **always on top**, the advantage of the Cling-Surface-treated belt varying from 14 to more than 100 per cent over the untreated belt.

The complete statement which Mr. Kent has prepared covering these tests is now printed in booklet form. If you wish, as you should, to improve economy in and in connection with your belts, we will be pleased to mail you a copy.

Cling-Surface stops slip, makes belts pliable, easy-running, and long-lived; waterproofs, and reduces friction. Best of all, it accomplishes this, and more, too, without making the belt sticky or leaving any deposit on the belt surface.

Cling-Surface is used all over the world with equal success—in the dryest, wettest, hottest and coldest climates.

Your order or inquiry will have our best and quickest attention. We quote f.o.b. Toronto.

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Cling-Surface
the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo N Y

I am interested in Cling-Surface and your trial order proposition.

Name ....

Position ....

City ....

State ....

73

For Services Rendered

Practically every testimonial that we receive and publish is a grateful acknowledgment for relief given, and services rendered by MAGNOLIA METAL on troublesome bearings where other babbitts failed.

It is on such a firm foundation that our business is built here, there, everywhere.

E. K. WOOD LUMBER COMPANY

Los Angeles, Cal., May 2, 1913.

Dear Sirs:—

Kindly allow me to congratulate you on the quality of your metal, which has given me the most perfect satisfaction. About 18 months ago I placed in my mill a 30″ x 6″ high-speed planer (the top head speed 4100), 2 7-16″ x 11″ bearings. From the first this planer gave me a great deal of trouble. The bearings burned out thirty days after I placed the machine in the mill. I bought a babbitt at 42 cents a lb. (being good babbitt) and repaired the machine with it, but with poor results (I am a mechanic of thirty-two years' experience). I then bought Copper Hardened Babbitt, which still did no good. On January 1st, 1913, I bought Magnolia Metal, and remetalled the bearings, and have been running ever since, eight and one-half hours out of the nine, and have had no trouble at all. Commenting upon the head 7″ diameter, 30″ length, with six knives and two 7-16″ x 11″ bearings, weight almost 900 lbs., in other words, 170% running balance, requires FIRST-CLASS BABBITT, and hereafter I shall use no other kind, for I must say, that Magnolia Babbitt gives perfect satisfaction.

Respectfully yours,

(Signed) L. EICHWALD, Mill Supt.,
E. K. WOOD LUMBER COMPANY.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

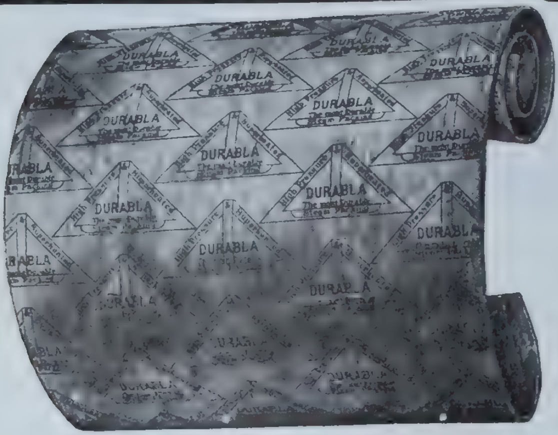
MAGNOLIA METAL CO.

TRADE MARK

OFFICE and FACTORY
225 St. AMBROISE STREET MONTREAL

TRADE MARK

DURABLA



Registered Trademark Stamped all Over the Sheet

SHEET PACKING

for Superheat and High Pressure, Wet Steam and Oil. It makes tight joints and keeps them tight Never pulps! Never blows out!

Canadian Sales Agents

CANADIAN FAIRBANKS-MORSE CO., Limited

Montreal, Ottawa, Calgary, St. John, Toronto, Saskatoon, Quebec, Winnipeg, Vancouver.

Manufactured by

DURABLA MANUFACTURING CO. NEW YORK

The "Bond" Patent Spiro Compression Coupling 50% more gripping force than any other Compression Coupling.

Security!

The "Spiro" Patent Compression Coupling expresses that word about as well as anything.

Once in place—it transmits the full power of the shaft—without any slip, without any attention whatever. And the reason is in the ever-tightening spiral grip.

Let us send our Catalog of Bond Transmission Specialties.

Canadian Bond Hanger & Coupling Co., Ltd.

ALEXANDRIA, ONT.

Toronto Office **249 Victoria Street**

"Maple Leaf" Brand

Stitched Cotton Duck Belting

THE BEST FOR ALL KINDS OF BELTS

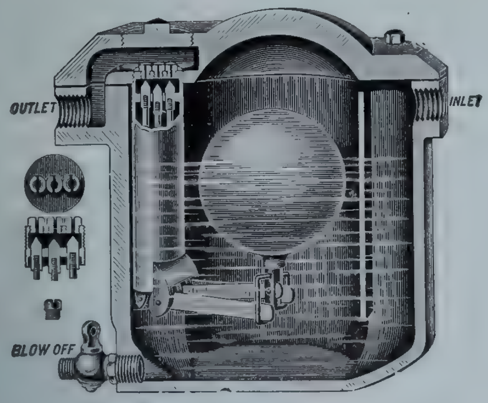
Means Reduced Upkeep Expense and Efficient Service

"MAPLE LEAF" is the strongest, truest running, and most economical belt on the market for Transmission of Power, Conveying, etc.

Ask us for further information and prices.

Dominion Belting Co., Ltd.,

HAMILTON, CANADA



Wright

"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited

15 Ottawa Street, MONTREAL

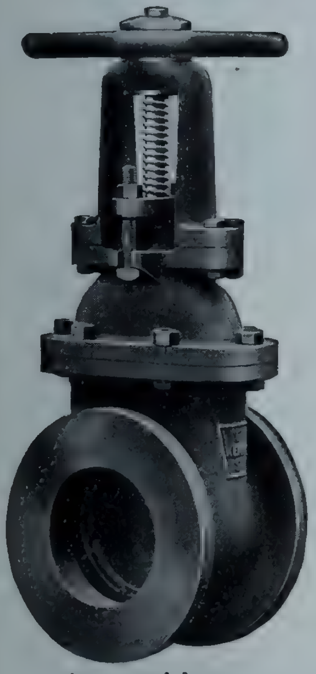
TORONTO WINNIPEG ST. JOHN, N.B.

KERR GATE VALVES

OUTSIDE SCREW AND YOKE

"KEYSTONE" PATTERN

Embody all the latest features

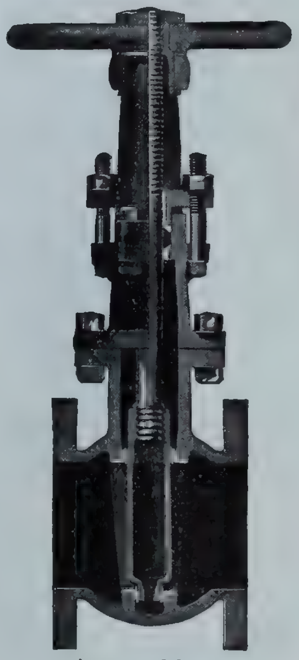


4½-in. and larger

- Screwed-in Seats
- Deep Bronze Bushed Gland and Stuffing Boxes.
- Full Opening.
- Large Diameter Hand-Wheels.
- Solid Wedge Discs.

4-in. and smaller

- Narrow face-to-face Dimensions
- Symmetrical Design.
- Good Material.
- Interchangeable Parts.
- Guaranteed Tested.



4½-in. and larger

The Kerr Engine Co., Limited, MANUFACTURERS
Walkerville, Ontario

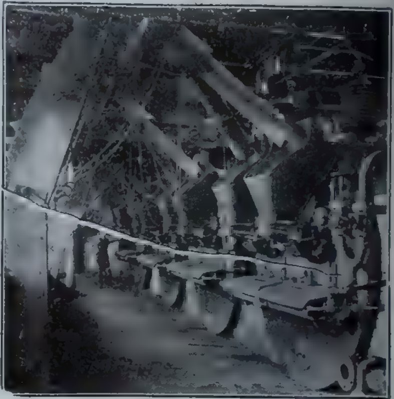
Bennis" New Long Link Chain Grate Stokers.

Bennis Chain Grate Stokers
Bennis Machine Stokers

with Patent Self-Cleaning Compressed Air Furnaces for Water Tube and Horizontal Return Tube Boilers.

Bennis Machines are supplying over 3½ Million Horse Power and are saving Millions of Dollars a Year.

"BENNIS" machines feed the fuel where the fire requires it, keep the fire at a nicely calculated distance from the boiler front, and responds to varying loads with a rapidity that is the outcome of good design. They ensure the maximum results from the boilers, reduce the fuel bill, and keep clean chimneys because they ensure good combustion.



For Cheap Steam without Smoke install "Bennis" Machine Stokers and Elevators.

"Bennis" stokers are not simply made from one design and adapted to meet the requirements of different types of boilers, but are specially designed for the various types, constructed with the greatest care and fitted to meet individual conditions.

The greatest economy is achieved when Bennis elevating and conveying plant feeds the stokers. "Bennis" coal and ash-handling plant has acknowledged advantages over other types, not only in design and construction, but in the small amount of power required to operate it effectually.

Write for "Boiler-House Economy" pamphlets and full particulars to

GEO. H. TOD, 213 Manning Chambers, Queen St. West, **TORONTO**
WINNIPEG, 601 UNION BANK BUILDING

LUNKENHEIMER POP SAFETY VALVES

Iron Body
Spring Encased

4-43

These valves are **economical** because they will **relieve only enough steam to reduce excessive pressures.** They can be positively relied upon to **operate promptly** and will not chatter or pound themselves to pieces.

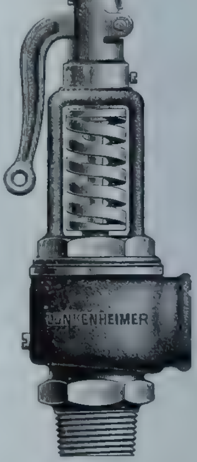
They can be regulated to reduce the pressure only one pound, if such close regulation should be desired, and adjustment of the pop and pressure can be made from the outside of the valve.

All parts subjected to wear are renewable. Either **Brass or Iron Body Valves** can be had, with encased spring or spring exposed.

For durability and reliability, **LUNKENHEIMER POP VALVES** have no equal.

Specify and insist upon having genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.

Your local dealer can furnish them; if not, write us. Write for catalogue.



Brass Body
Spring Exposed

THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of High Grade Engineering Specialties in the World.

Executive Offices and Factories: CINCINNATI, OHIO, U. S. A.

New York, 64-68 Fulton St.
Chicago, 188 N. Dearborn St.
Boston, 138 High St.
London, S. E., 35 Great Dover St.

"Columbia" Recording Thermometer

For any temperature range not over 1000 deg. F.

With popular "Day and Night" border chart—uniformly graduated.

With new, patented removable recording pen arm—chart changing made easy

With new, patented insulated covering for steel connecting tubing.

Mercury actuated — steel construction.

Accurate and durable.

Instruments for Power Plant Testing

ARE you running YOUR Boiler Room—YOUR Engine Room—or the Power Plant under YOUR control on a "maximum of efficiency with minimum expense" basis? If not, you are not working for the interests of your Boss—and incidentally not for your own interests.

Of course, to run things on a systematic basis, you must have proper testing instruments. That is where we come into the story.

Since 1850—nearly 63 years ago—the House of Schaeffer & Budenberg have manufactured "Instruments for Power Plant Testing"—Instruments of Quality and Precision. And with the knowledge accumulated during this time, we have maintained a SERVICE DEPARTMENT to solve YOUR problems.

Our Catalogs and Our Service

You should have a set of our catalogs. They are mighty interesting and very instructive. Why not write for a set NOW? And while you are writing, think—isn't there some problem we can solve for you? Tell us your troubles—we can help you. **It costs nothing.**

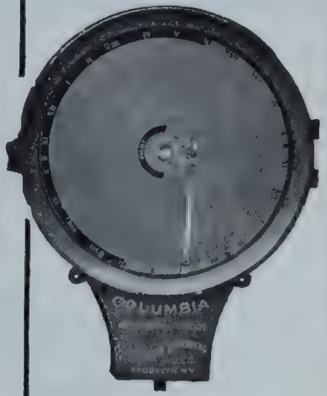
The
Schaeffer & Budenberg Mfg. Co.

Makers of
Gauges, Tachometers, Indicators, Thermometers, Calorimeters, Counters, etc., etc.

Brooklyn, New York

161

"Columbia" Recording Gauge



For any range of pressure or vacuum.

With popular "Day and Night" border chart.

With new, patented removable recording pen arm—chart changing made easy.

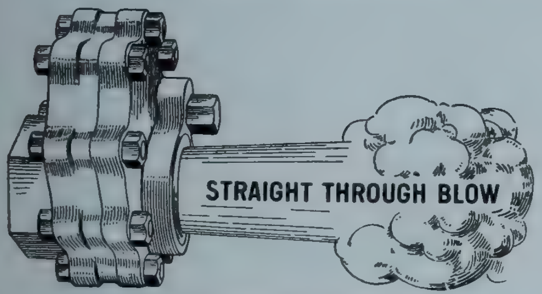
Mechanically perfect—rugged in construction.

Accurate and durable.

EVERLASTING

BLOW-OFF VALVES

200,000 IN USE



IT NEVER LEAKS!

WRITE FOR PRICES

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiler & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

The advertiser would like to know where you saw his advertisement—tell him.

THERE MUST BE A REASON—FOR REPEAT ORDERS
FOR

Murphy Automatic Smokeless Furnaces

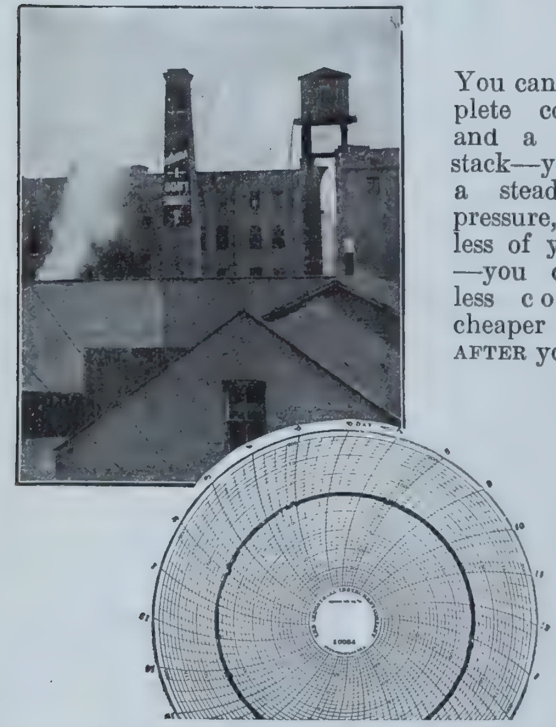
West Virginia Pulp & Paper Co.	-	**Piedmont, W. Va.**
1st order, July, 1901	20 furnaces	6,500 H.P.
2nd order, July, 1904	2 "	600 H.P.
3rd order, Apr., 1905	2 "	600 H.P.
4th order, Apr., 1907	4 "	886 H.P.
5th order, Dec., 1913	8 "	2,400 H.P.
	36 furnaces	10,986 H.P.

81 Paper and Coating Mills executed **188 contracts** for Murphy Furnaces—**86 repeat** orders—for **546 furnaces** = **144,236 H.P.**

THE LOCKPORT PAPER CO., Lockport, N.Y., has been using Murphy Furnaces, 24 hours per day, 365 days per year, **FOR 29 YEARS**. "THERE MUST BE A REASON!"

MURPHY IRON WORKS,
DETROIT, MICH.
BUFFALO, N. Y.

You can do it in Your Plant, too

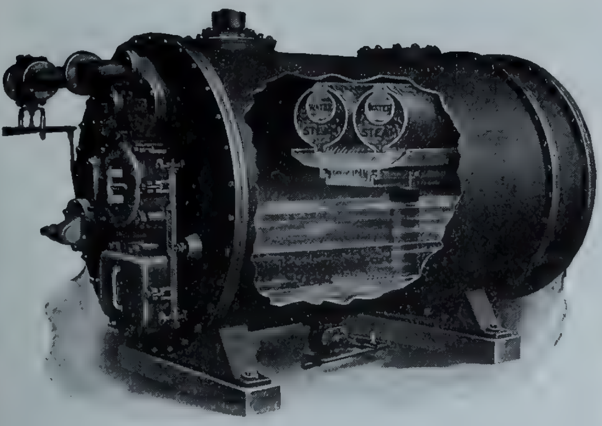


You can get complete combustion and a smokeless stack—you can get a steady steam pressure, regardless of your loads—you can burn less coal, and cheaper coal—AFTER you instal a

JONES UNDERFEED STOKER

What the Jones Stoker is doing in this plant at London, Ont., and what it is doing in hundreds of other plants, it will do in yours.

JONES UNDERFEED STOKER CO., LIMITED
NATIONAL TRUST BUILDING - TORONTO



Contact Pipes.

IN THE

NATIONAL

DIRECT CONTACT FEED WATER HEATER AND PURIFIER

the water is first heated by surface contact and then brought to maximum temperature by actual contact or mingling with the steam. This is the feature which distinguishes the National from all other open heaters.

The contact pipes are double. From the inner, the water overflows the port at the top, and passes around the large pipe as a thin film. It is broken into fine spray at the bottom. The steam leaving the outer pipe at the bottom passes through the spray and finally all water and steam are in direct contact above the filter bed.

Other features explained in Catalog No. 2

The National Pipe Bending Co.
91 Lloyd Street
New Haven, Connecticut

149 Broadway, New York **54 High Street, Boston**

Makers of Pipe Coils and Bends of Every Description—for all purposes—Iron, Brass, Copper.

46-57

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47 "clean-cut" answers

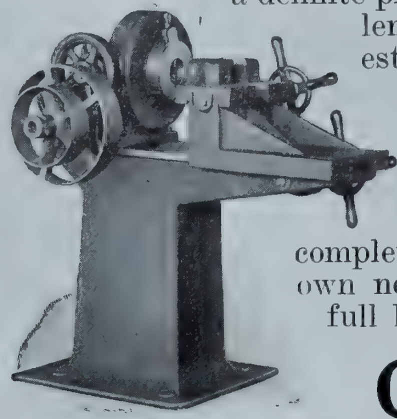
EVERY one of the 47 machines in the Oster line is a **scientific, correct** answer to a definite pipe-threading problem. From the smallest to the largest, each one is a proof of our belief in the utmost quality and thoroughness. You will find the complete answer to your own needs in one of the full line of

OSTER

Pipe-Threading Tools

For twenty years we have been improving and developing the pipe-threading tool until to-day, these 47 tools are recognized the world over as the standard equipment. No detail which could possibly increase the satisfaction of users has been neglected in the manufacture of this line. We have always believed in the **best** workmanship, and the **best** material, knowing that in the end, Quality is Economy.

Oster 300 A



threads nipples, short bends, besides regular pipe-threading.

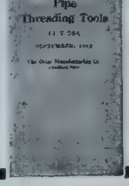
Bulldog Die-Stock No. 102

threads six sizes, from ¼" to 1¼".

Are you satisfied with the cost of your pipe-threading labor? Better read "Labor-Saving Machinery." Send us to-day the coupon below and we will gladly send this booklet by return mail.

28 Canadian cities have Oster jobbers — "It's easy to get an Oster."

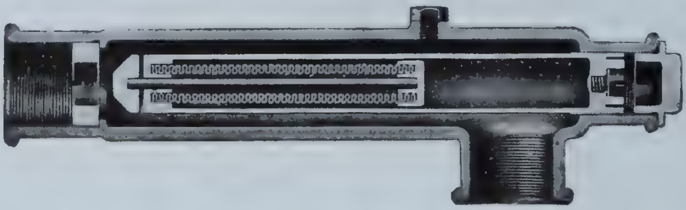
The
Oster Mfg. Co.
2099 East 61st Street
Cleveland, O., U.S.A.



Kindly send me by return mail your completely illustrated catalog and "Labor-Saving Machinery."

Name ....
Business ....
Address ....
City ....
State ....(2099)

We Promise to Give You Surer Trapping At But One-Third The Cost

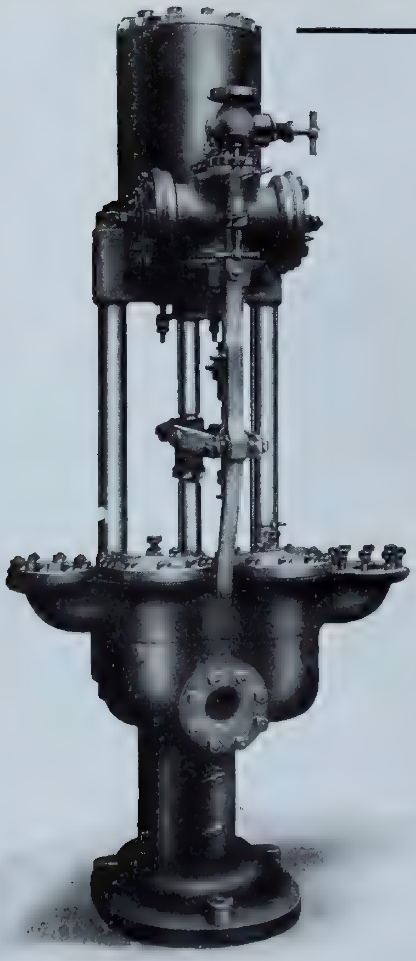


THE **SARCO** Steam Trap is radically different from any other type made. It is the SIMPLEST and the LOWEST PRICED on the market, yet it is tremendously *effective.* A Sarco is a SURE trap.

Over a QUARTER OF A MILLION now in use.
We'll Send You A Sarco To Give A Try-out

Send for price list and leaflet No. 5

PEACOCK BROTHERS
MONTREAL VANCOUVER



"WEIR"

THE UNSURPASSABLE PUMP

THE GREATEST EFFICIENCY. THE GREATEST ECONOMY.

Over 50,000 now in use.

Feeding Upwards of 120,000,000 Horse-Power

The Largest Vessel in the World,
The Largest Battleship in the World,
The Most Powerful Battle Cruiser,
The Fastest Torpedo Boat Destroyer,
The Most Luxurious Yacht Afloat,
The Greatest Dredger,
Are all fitted with WEIR AUXILIARIES.

The largest and most up-to-date plants in Canada are all equipped with

Weir Feed Pumps

List of Canadian users sent upon application.
Send for catalogue No. 4.

SOLE AGENTS

PEACOCK BROTHERS
Montreal Vancouver

W. H. ALLEN, SON & COMPANY

LIMITED

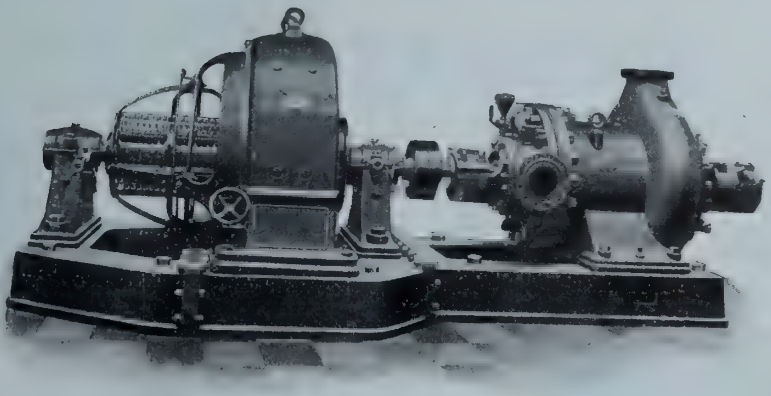
QUEEN'S ENGINEERING WORKS, BEDFORD, England

ENGINEERS AND BUILDERS OF

Steam, Hydraulic and D.C. Electric Machinery

"CONQUEROR" PUMPING MACHINERY

Suitable for low heads and up to 1,800 feet.
Constant power, constant speed, with
varying head and quantity

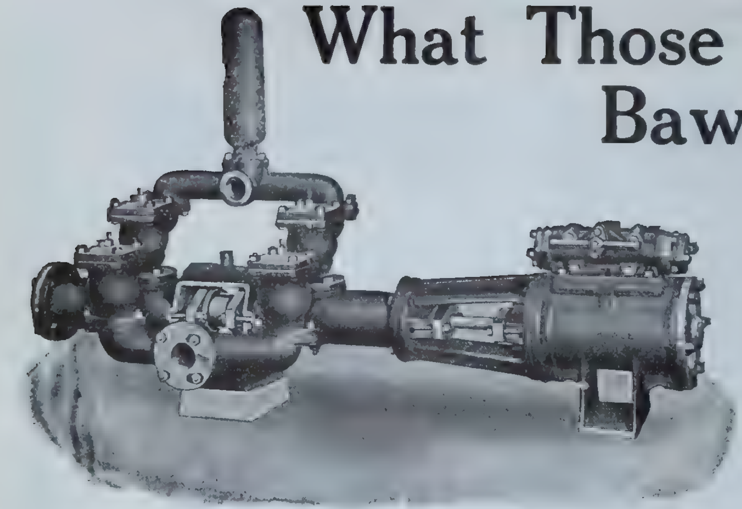


"Conqueror" High-Lift Turbine Pump, driven by Continuous-Current Motor.
525 Gallons per minute, 1,450 ft. head.

For prices and full particulars, apply to the head office at

BEDFORD, England

What Those Who Know Say Of Bawden Pumps



A User:

"I would never know I had a pump, as it needs no attention."

An Engineer Who Has Specified Them on a Number of Large Jobs:

"It is the best pump I ever saw."

An Engineer Who Made Tests:

"I don't know another pump made that will stand those tests like that pump."

A Large Manufacturer:

"It is the best made pump I ever saw and a credit to Canada."

A Contractor Who Uses Them on All His Jobs:

"I put them in, they start right off, and I never have a complaint, so they must be good."

A Prospective Customer:

"I called up the users you gave me, and will take your pump."

Pumps for all purposes.
Write for Catalogue and Calendar.
And learn why Bawden Pumps cannot Short Stroke or Bang.

¶ The Bawden Pumps are operated by the Bawden Patent Balanced Steam Moved Piston Valves, which insures a Full Stroke of the piston under all conditions. There are no outside rods to stick or get out of adjustment.

¶ The water valves have no screwed seats, but are driven in on a special taper and are held solid by brass stoppers through the covers, all parts made on jigs and faces machined, so no sheet rubber packing is required.

Quebec Agents: H. L. Peiler & Co., 380 St. James St., Montreal

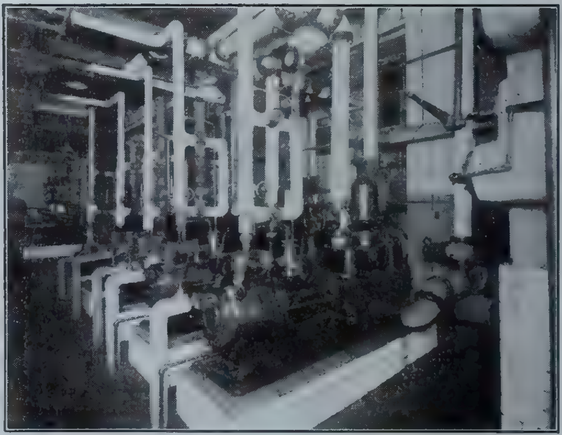
The Bawden Machine Co., Limited

125-137 Sterling Rd.,
TORONTO, CANADA

MARSH and AMERICAN
Pumping Machinery
For Every Service

Accompanying cuts illustrate an installation of Marsh and American Pumps made in the new C. B. & Q. office building in Chicago, Ill.

Marsh and American Pumps will also be found in many of the largest hotels and office buildings in the United States and Canada, including the McAlpin, Knickerbocker and Clarendon Hotels in New York City, the Brevoort and Blackstone Hotels in Chicago, the new Northwestern Terminal in Chicago, the new Michigan Central Terminal in Detroit, and the Simpson Department Store, Toronto.



Boiler Feed and Vacuum Pumps.

Elevator Pumps.

Marsh Pumps have been on the market for over 25 years, and continue to be the choice of discriminating engineers who desire the utmost in quality and reliability, regardless of first cost.

Our slogan: Simplex not Duplex. "To be simple is to be great."

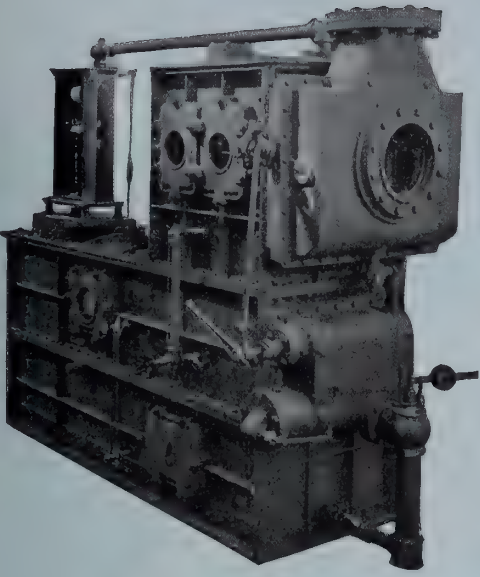
Write for Bulletins.

AMERICAN STEAM PUMP CO.

BATTLE CREEK, MICH.

CANADIAN AGENTS:
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman Machinery Co., Vancouver, B.C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited, Edmonton & Calgary.

POWER PLANT EQUIPMENT



COCHRANE FEED-WATER METERS

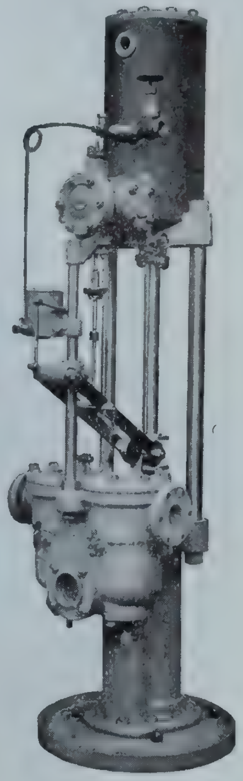
WITH V-NOTCH WEIRS

By means of these meters the boiler owner or operator is able to determine the most economical grade of coal and the most efficient method of operating boilers.

The V-Notch weir furnishes an absolutely reliable basis upon which to construct a convenient and accurate feed-water measuring apparatus. For full discussion of the principles involved **see bulletin 591.**

MATHER & PLATT

BOILER FEED PUMPS



We build both reciprocating and turbine pumps from Mather & Platt designs for boiler feed and other purposes. The attached cut shows a Mather & Platt Patent Vertical, Direct-Acting Steam Pump for Boiler Feeding purposes, suitable for 200 lbs. pressure.

Note slow speed, long steady stroke, roller bearings on motion levers, patent group valves, gunmetal-lined water cylinders; water pistons fitted with ebonite rings; pumps made in sizes from 810 to 10,000 Imp. gallons per hour. Size illustrated, 8 x 6 x 18.

CANADIAN ALLIS-CHALMERS

LIMITED

Manufacturers of:—Air Compressors, Boilers, Cement Making Machinery, Concrete Mixers, Flour Mill Machinery, Gas Engines, Hoisting Engines, Hydraulic Machinery, Locomotives, Mining Machinery, Ornamental Metal Work, Rock Crushers, Rock Drills, Saw Mill Machinery, Steam Pumps, Steam Specialties, Steam Shovels, Steam Turbines, Structural Steel, Transmission Machinery, Turbine Pumps, Water Pipe, Water Wheels.

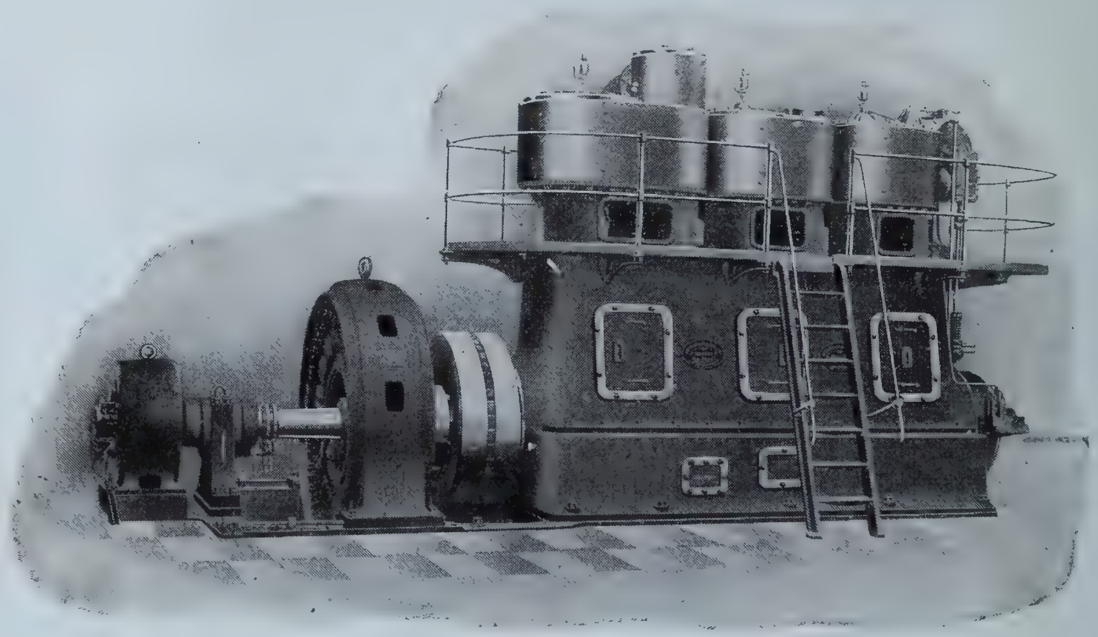
Head Office: TORONTO. District Sales Offices: Montreal, Halifax, Cobalt, Ottawa, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

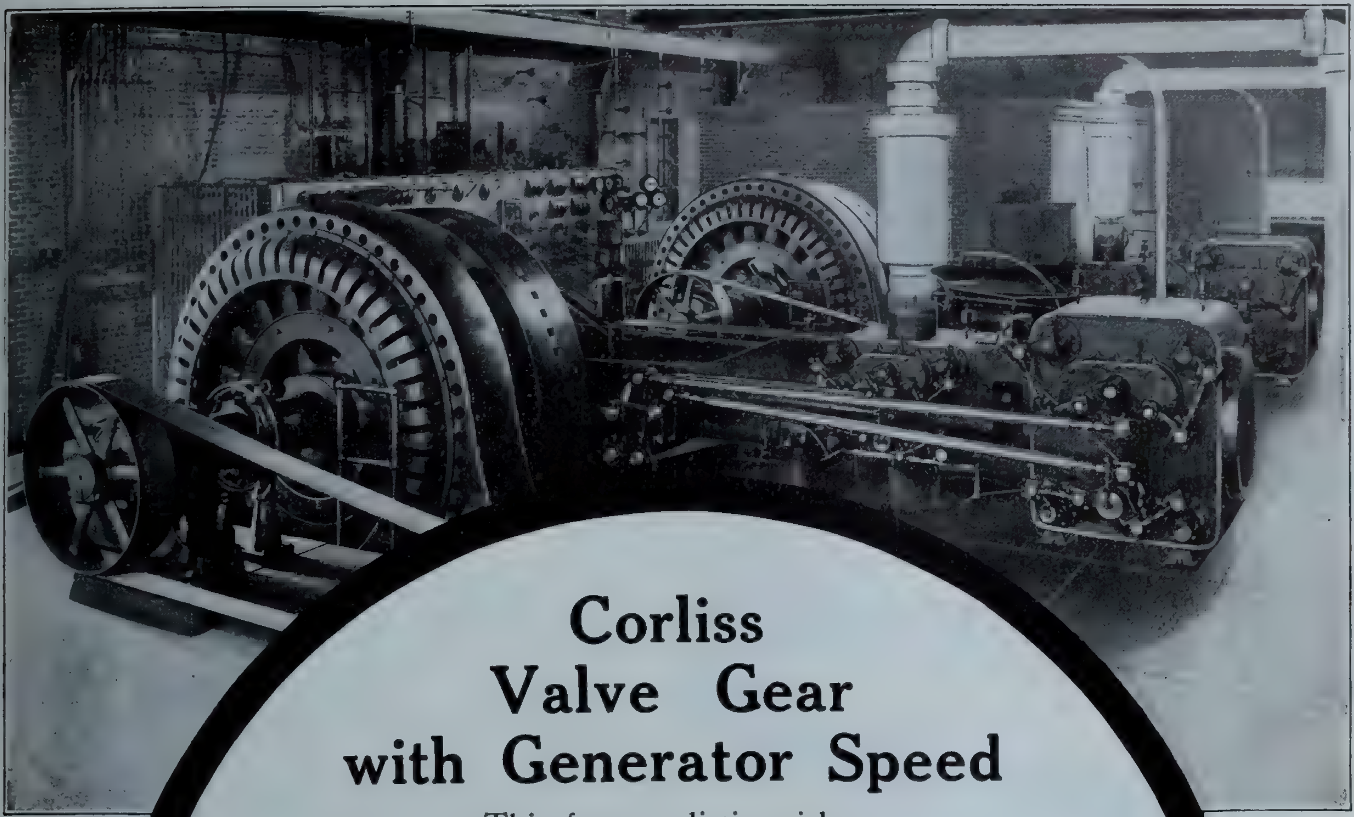
Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.



Corliss Valve Gear with Generator Speed

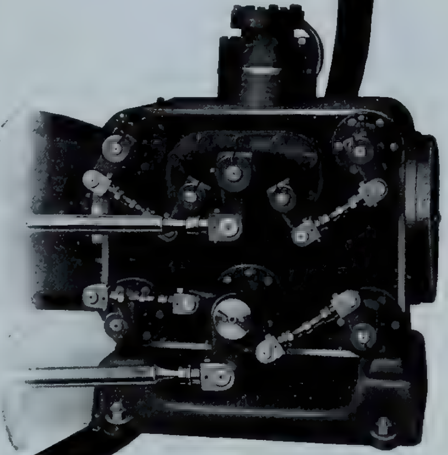
This feature distinguishes

Robb Corliss Engines

A {simplified} valve gear, multi-ported valves, short stroke, and compact frame permit a speed of 250 revolutions per minute with a moderate piston speed.

A thoroughly modern design, combining dependability, low repair expense, low steam consumption, and complete enclosure for retaining oil and returning it to the bearings instead of throwing it about.

Half as many parts to wear, no springs, no dash pots, no latches, no cams, no disengaging parts —but Corliss steam distribution and small clearances.



Ask for Bulletin 202

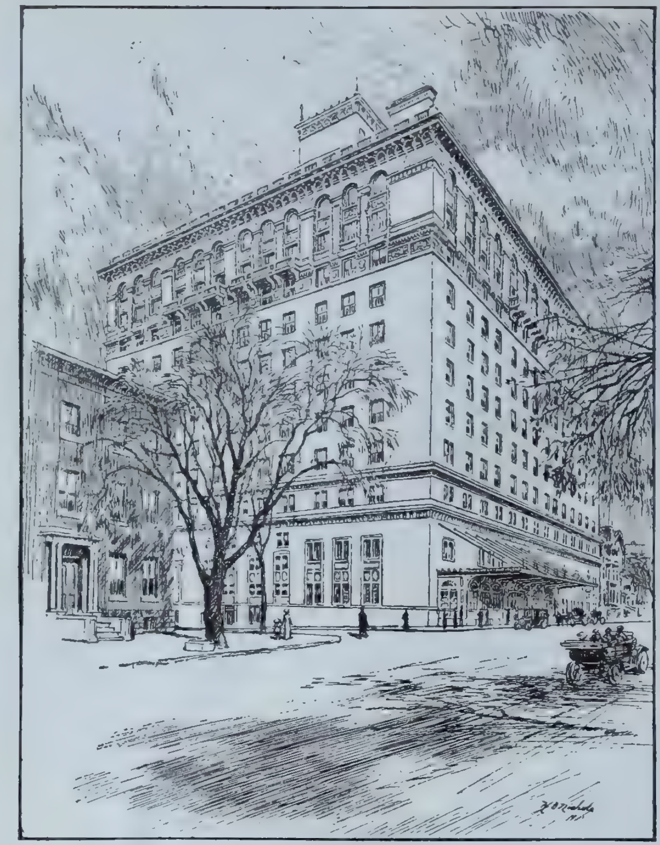
Scotch Boilers
Vertical Engines
Horizontal Boilers
Water Tube Boilers

INTERNATIONAL
ENGINEERING WORKS, LIMITED

SOUTH FRAMINGHAM, MASS. **AMHERST, N.S., CANADA**

DISTRICT OFFICES: 9-64

Transportation Building, Montreal......R. W. Robb, Manager
Traders Bank Building, Toronto......E. F. Bradley, Manager
641 York Street, Edmonton ....W. F. Porter, Manager
Grain Exchange Bldg., Calgary ....J. F. Porter, Manager
1057 Hamilton Street, Vancouver ....Geo. M. Taylor, Manager
321 Edmonton Street, Winnipeg ....J. F. Tracy, Manager



Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Toronto **MONTREAL** **Winnipeg**

First of a series of advertisements showing buildings of national importance which have been wired with Imperial Wire & Cable Co., Limited, wires.

This picture shows

The Ritz-Carlton Hotel
Montreal

Architects—Warren & Wetmore—New York;
Engineers—Mailloux & Knox — New York;
Electrical Contractors—J. Livingston & Co.—New York.

This hotel was wired with "Imperial" Higrade Rubber Insulated Wire.

Address enquiries to nearest office

MONTREAL **TORONTO** **WINNIPEG**

Alberta and British Columbia enquiries to our Sales Agents, The Northern Electric and Manufacturing Co., Limited, Calgary and Vancouver.

NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

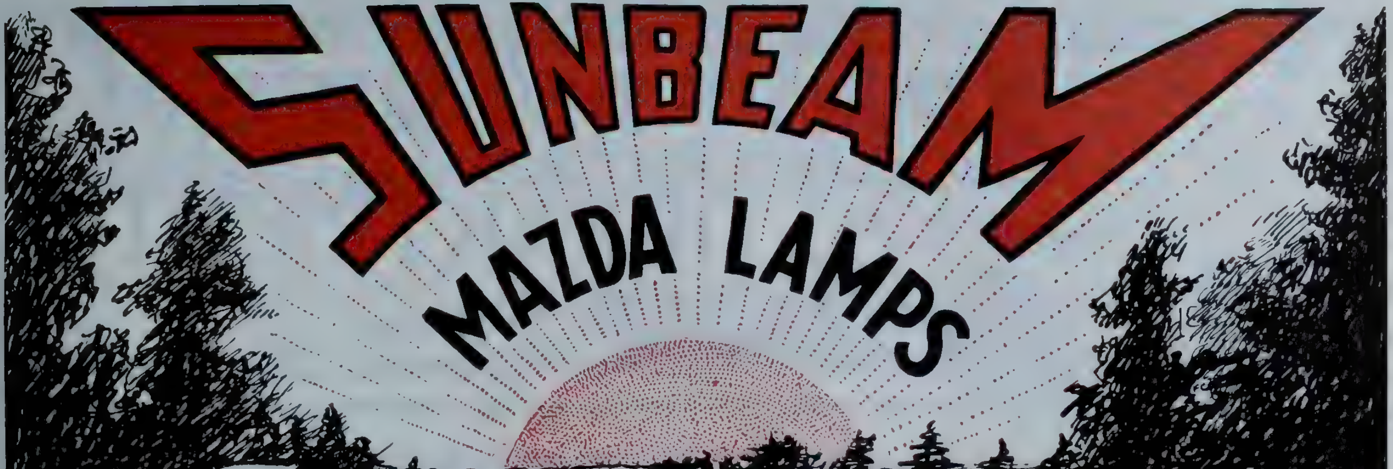
THE UNBREAKABLE KIND

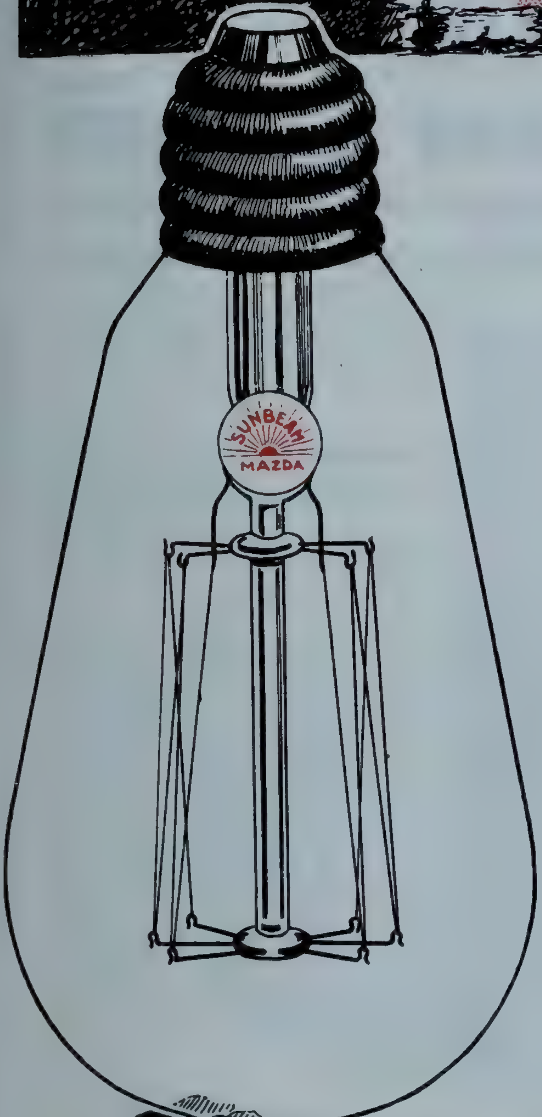
Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN CO., Limited

Live Agents wanted all over Canada. 23-25 Dowd Street **MONTREAL**





Your workmen's eyes and nerves

need to be kept in good condition to turn out the best quality work.

An inefficient light makes bad eyes, and is a big strain on the nerves.

By placing a **Sunbeam Mazda Lamp** in every socket your lighting system will be efficient—you will GET THREE TIMES THE LIGHT OF THE ORDINARY CARBON LAMP at the same electrical consumption, and insure quality production.

Sunbeam Mazdas are as rugged as any Carbon Lamp—they will burn in any position.

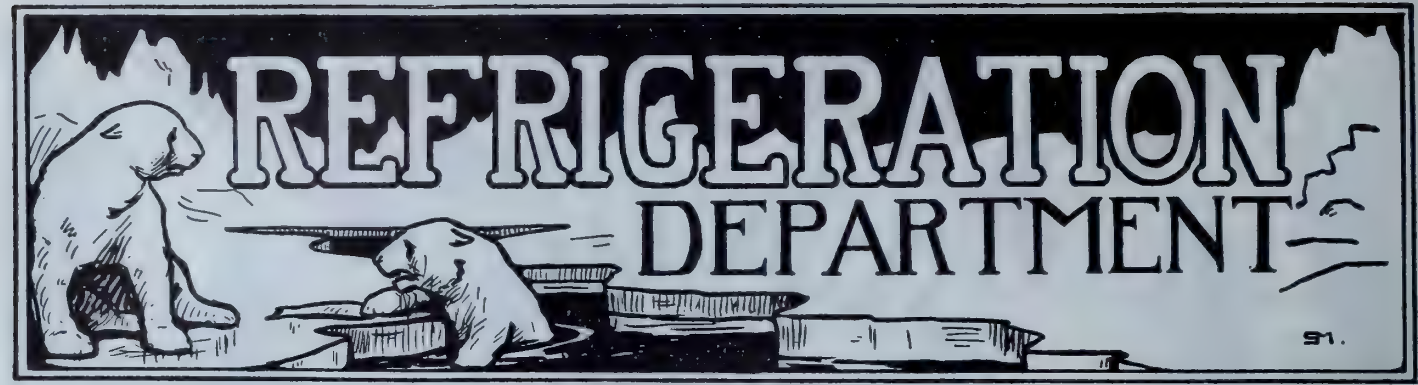
Fully guaranteed—we ship promptly.

The Canadian Sunbeam Lamp Co., Limited

Main Office and Factory: TORONTO

Branch Warehouses: Montreal, Winnipeg, Calgary, Vancouver

THREE TIMES THE LIGHT AT THE SAME COST

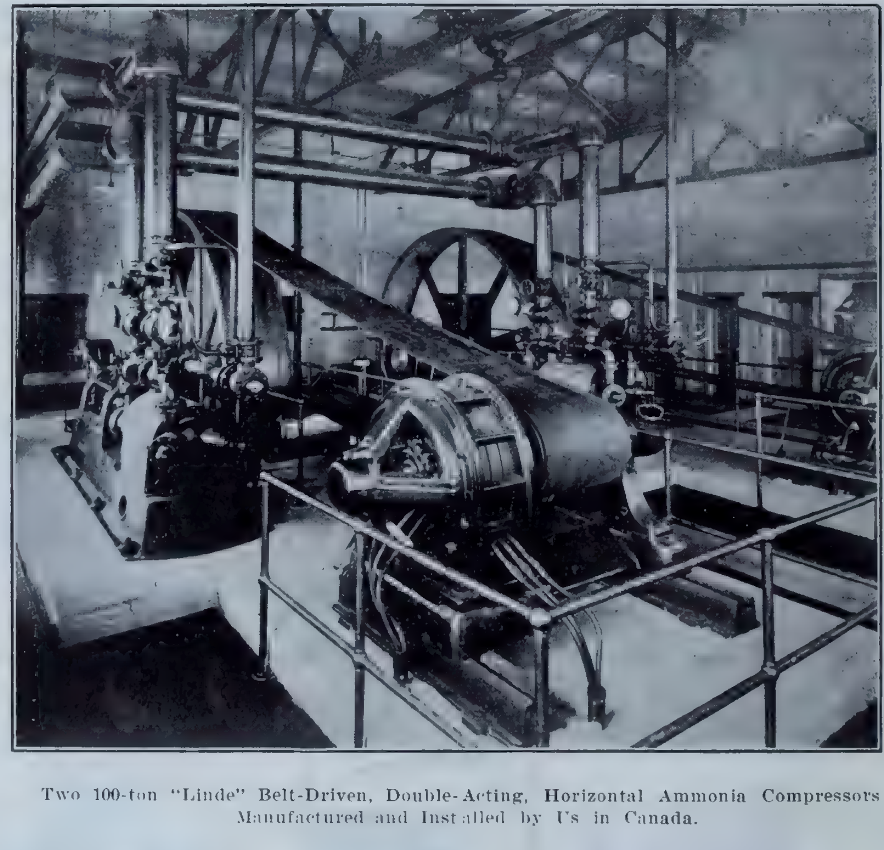


"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogs and estimates upon request.

The Linde Canadian Refrigeration Co.,

Limited

37 ST. PETER STREET, MONTREAL

Branch Offices—Toronto, 28 Front St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, 562 Second Street; Calgary, 320 P. Burns Building.

Greatest Output in the World of Refrigerating Machinery

This Company has installed over eight thousand six hundred (8600) Ice Making and Refrigerating Plants in all parts of the world. For 27 years, the name **"Linde British"** has stood for the best there is in Ice Making and Refrigeration Machinery.

The Linde-British REFRIGERATION COMPANY LIMITED
Head Office, London, England
CANADIAN OFFICES
CORISTINE BLDG.
Montreal

Our Experts are at your service to originate, plan and estimate on any refrigerating problem you have on hand. Write us.

ANHYDROUS 100% EFFICIENCY AQUA

CANADIAN AMMONIA CO. LTD. TORONTO. CANADA

"EXCELSIOR" AMMONIA
THE PLANT BEHIND THE PRODUCT

CANADIAN AMMONIA CO., Ltd.

TORONTO ∴ ONTARIO

LARGEST AND OLDEST MANUFACTURERS IN CANADA

STOCK CARRIED AT
HALIFAX, N.S. MONTREAL, QUE. WINNIPEG, MAN. VICTORIA, B.C. VANCOUVER, B.C.
ST. JOHN, N.B. QUEBEC, QUE. CALGARY, ALTA. PRINCE RUPERT, B.C.

THE BEST INSULATION

For Cold Storage and Refrigerating Work is

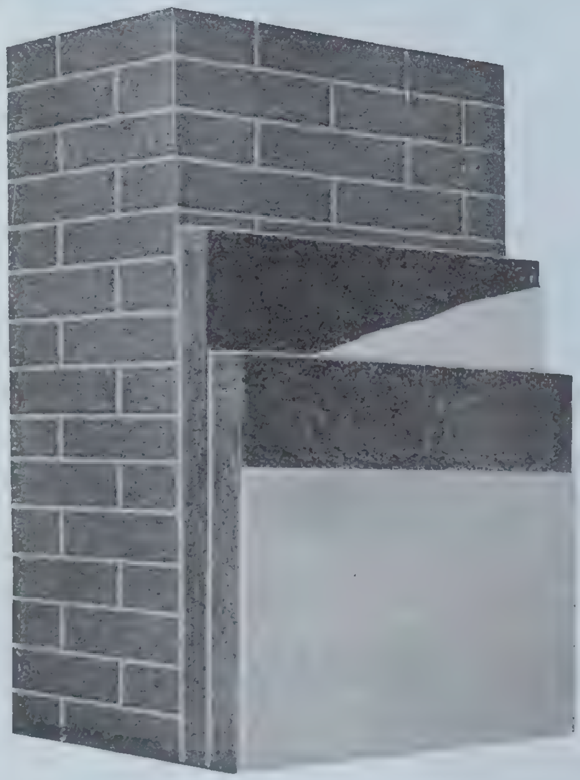
CORKBOARD

We are the only Firm in Canada Manufacturing
CORKBOARD INSULATION

WRITE TO US FOR QUOTATIONS AND FULL PARTICULARS

ROBINSON BROS. CORK COMPANY,
LIMITED

Head Office—803 Lumsden Bldg., Toronto. Factory—Port Colborne, Ont.



NONPAREIL CORKBOARD
The type of construction approved by the Underwriters

Nonpareil Corkboard Insulation

for

COLD STORAGE WAREHOUSES, BREWERIES, PACKING HOUSES, ABATTOIRS, CREAMERIES, Etc.

Secures the highest insulation efficiency by its purity.

There's nothing in it but that best of insulating agents, PURE CORK.

That is why it was USED EXCLUSIVELY IN THE FRONTENAC BREWERIES, MONTREAL, where the highest efficiency was demanded.

NONPAREIL, CORK COVERING FOR BRINE, COLD AND ICE WATER PIPES also gives the greatest service.

NONPAREIL HIGH-PRESSURE COVERING,—a new and better steam pipe and boiler covering, made of Nature's best heat-insulating material—diatomaceous earth.

NONPAREIL INSULATING BRICK, for Boiler Settings, Bake Ovens, etc.

THE KENT COMPANY, LIMITED

Montreal, Que.

J-M PURE CORK SHEETS cut refrigerating cost 23%

Here's the proof.

After a few years' service a building with an exposed area of 40,000 sq. ft., insulated in the old way with mill shavings, usually requires 3,500 tons of refrigeration to maintain a temperature of 30 degrees during the eight Spring, Summer and Fall months when the average outside temperature is 80 degrees.

Insulated with J-M Pure Cork Sheets it requires only 2,666 tons to keep the temperature at 30 deg. A saving of 833 tons, or 23.8% of refrigeration.

At 50c. per ton this represents a saving of $416.50 in one season.

And the increase in storage capacity made possible in a building of this size by J-M Pure Cork Sheets means an additional increase in profit of $1,320.00 for the same term, figuring storage space at 8c per cubic foot per season.

Unlike old-fashioned insulation, J-M Cork Sheets are not affected by moisture —never rot or crumble—and last as long as the building in which they are installed. And they are approved by the Fire Underwriters.

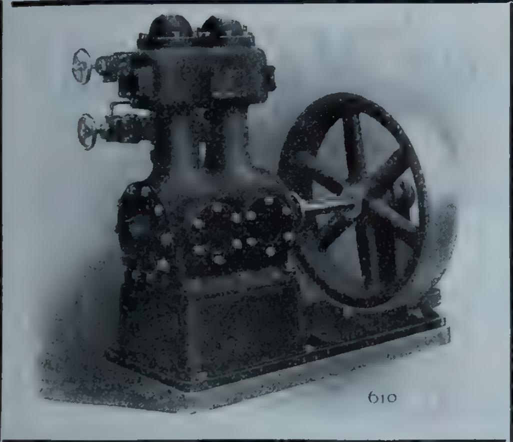
You can reduce your maintenance cost and increase the storage capacity of your plant. Let our engineers show you how. It won't cost you a cent or place you under the slightest obligation for the information. Write Nearest Branch.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Boiler Preservative; Conduit; Metallic Hose; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners, Etc.

Toronto Montreal TRADE ASBESTOS MARK Winnipeg Vancouver

2193



610

THE WORLD'S LARGEST PLANT for the Manufacture of Ice Making and Refrigerating Machinery

Being Made Larger to Accommodate the INCREASING DEMAND FOR ITS PRODUCTS

Owing to the steady increase in the demand for YORK Ice Making and Refrigerating Machinery it became necessary, recently, to again enlarge our Plant. An entire City Block, comprising the property of The Hench & Dromgold Co., is our latest acquisition.

No Company can grow as we have grown unless its output possesses merit. Each year, during the past decade, has shown an increase in our annual sales. We say this not boastfully, for we realize that this very favorable showing is due, in a large measure, to the loyalty of those who think well of YORK Products.

The World's Largest Plant—but our complete modern factory equipment enables us to give your smallest order the most careful and prompt attention, as well as to make the quickest possible delivery of the largest orders.

Think it over. We believe you will find it profitable to cultivate an acquaintance with YORK PRODUCTS.

YORK MANUFACTURING COMPANY, York, Pa.

Represented in the Dominion by CANADIAN ICE MACHINE COMPANY

TORONTO, 163-167 Yonge Street MONTREAL, 324 Coristine Bldg. WINNIPEG, 80 Lombard St.

The above machine is very desirable for those desiring only a small amount of refrigeration. Ask for prices.

Write to

KEITHS LIMITED

109-111 King Street W.
TORONTO, CANADA

Our Canadian Representatives as to the efficiency of

FRICK

Refrigerating and Ice-Making Machinery and Equipment

We build all types of Machines. Get our Catalogue.

FRICK COMPANY
Waynesboro, Pa., - - U.S.A.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

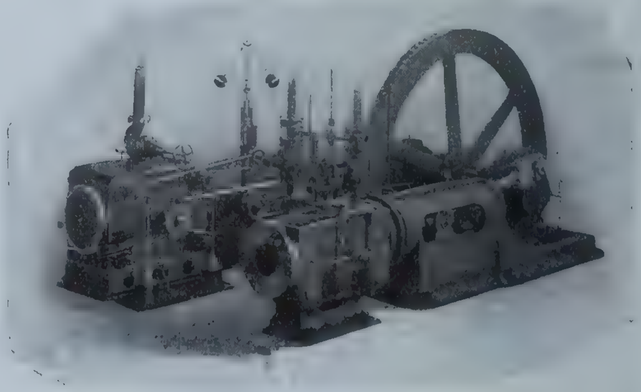
The name De La Vergne stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada



J. V. Jamison, President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

The Correct estimated value of

A Refrigerator Door and Window

—is service.

1st. Efficiency
2nd. Strength and Durability.

Jones Cold Store Door Co.

Hagerstown, Maryland

products combine and recommend to the trained and untrained eye, unexaggerated ability to perform its work and to stand up to its place. The construction object is in defiance to the

Slam Bang Laborers "Disable Me If You Can"

HINGES AND FASTENERS weigh 60 lbs. to the set. The Doors and Windows work as easy as the front Door on your dwelling.

They will not leak.

Refrigerator Doors and Frame and Windows mean shipped complete ready to set in the opening.

We guarantee our "AD" statements.

We believe a big part of our success is due to pleasing our Patrons.

We are the sole manufacturers of the "NOEQUAL" DOOR with round jambs, so popular with the packing trade.

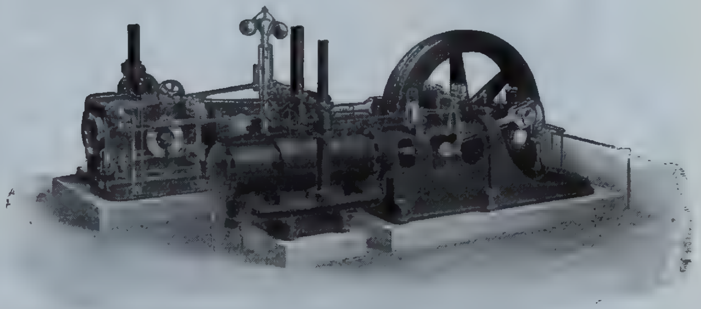
Our Revolving Ice Cream Door is a success for its purposes.

Our Ice Doors and Chutes do all that is required.

Jones Cold Store Door Co.

HAGERSTOWN, MD., U. S. A.

Arctic Ice Plants
In Canada



are bringing orders for similar outfits wherever installed. Why? For one thing, we guarantee:

> **20% more duty for a given size than any other horizontal ice machine built.**

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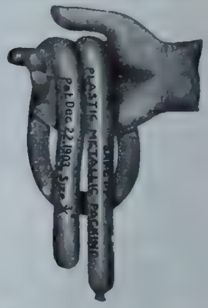

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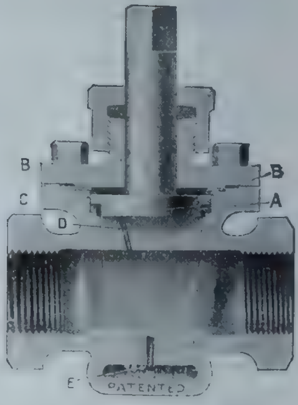

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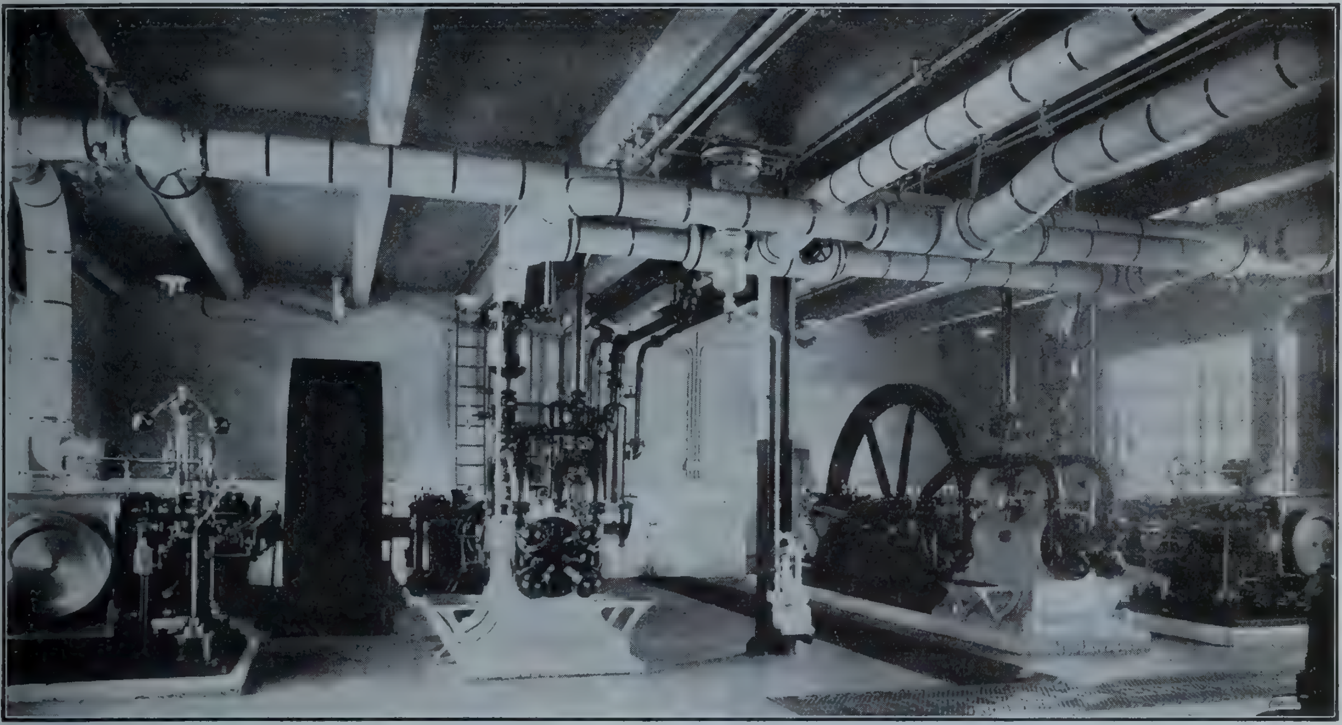

Portion of the Engine Room of the Frontenac Brewery, Limited, Montreal, showing the **VILTER 250-TON REFRIGERATING PLANT** in operation.

(See page 38 for further information.)

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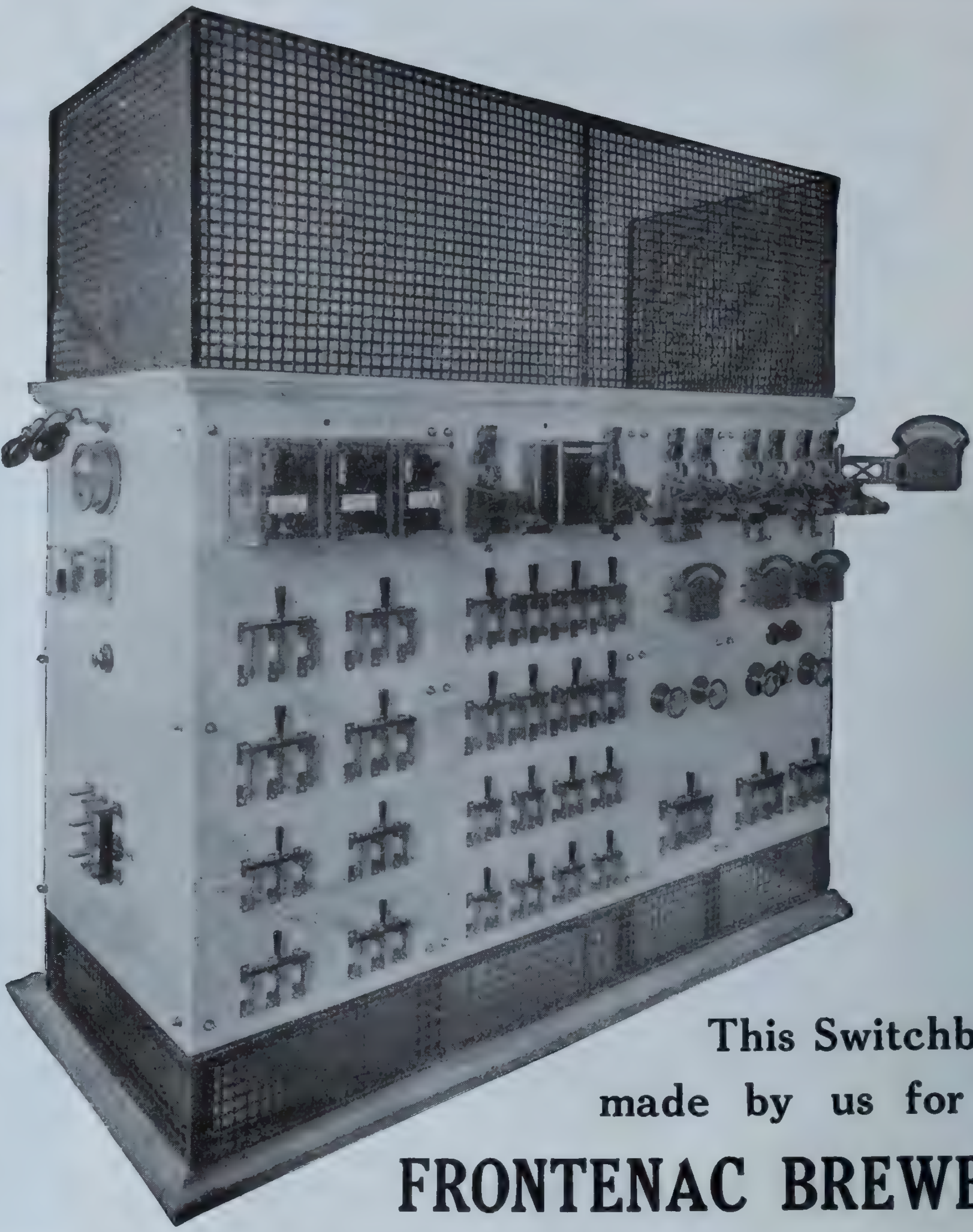

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is an evidence of what you may expect when the highest engineering skill as applied to switchboard design is combined with expert and thorough workmanship.

A full description of this switchboard appears in this issue in connection with the article on the Frontenac Brewery.

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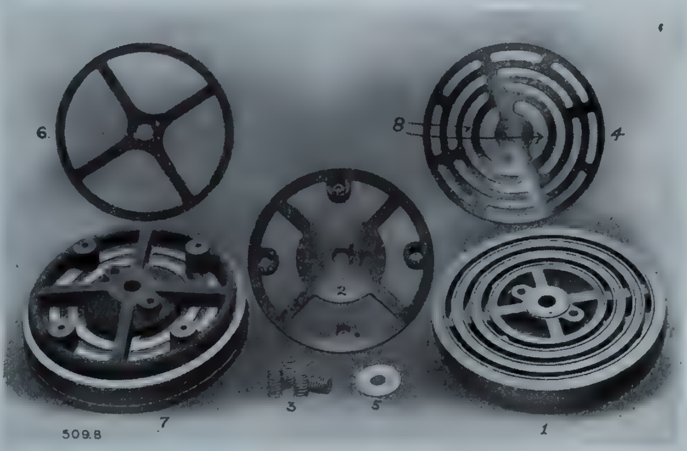

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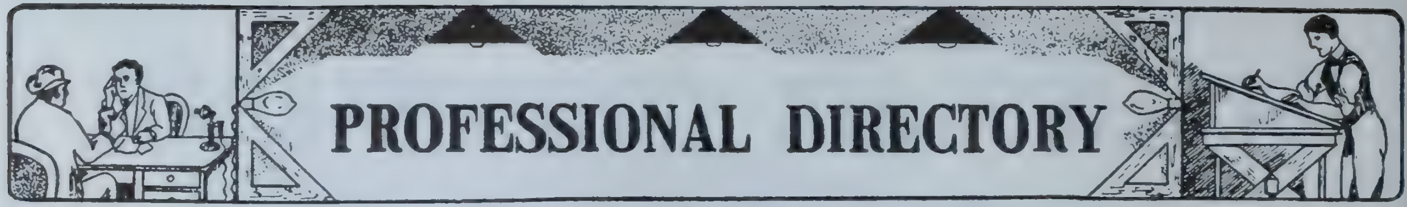

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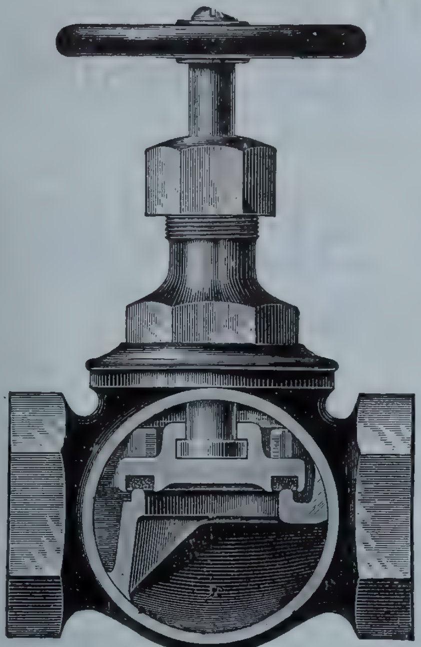

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should be used on all your high-pressure lines.

Tested under the most severe conditions, their great durability and strength enable them to give the greatest service.

High-class workmanship, and improved design, by Valve Experts, render them absolutely dependable at all times.

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the principal feature of Fairbanks Valves, owing to its composition of long-fibred Asbestos and rubber, with a special binding process, is long lived, unbreakable, tough, yet sufficiently soft to cushion perfectly with the valve seat. The RAISED ROUND SEAT is practically self-cleaning, its shape preventing the lodging of foreign substances which might injure or destroy the seat.

FAIRBANKS DISCS are easily renewed; simply remove the valve bonnet and slip a new disc upon the end of the spindle.

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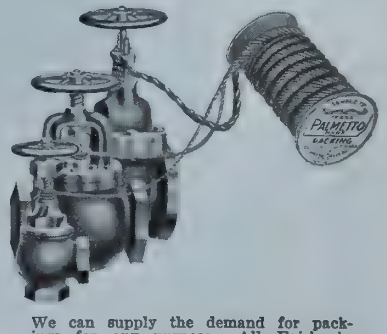

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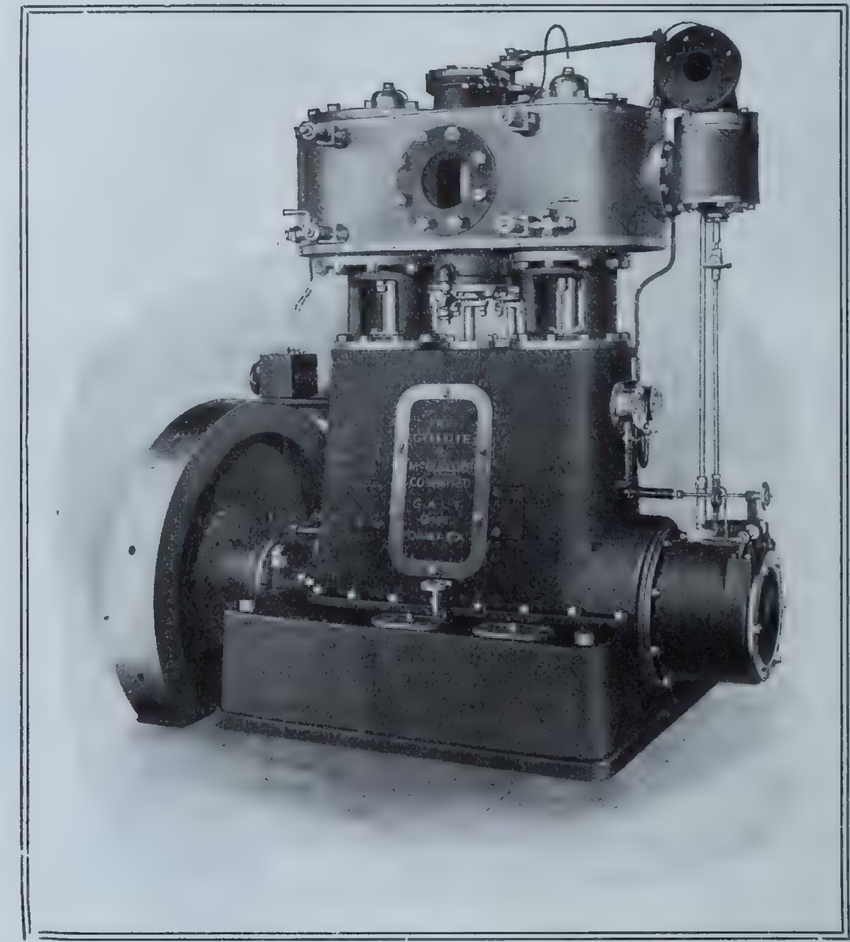

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They run with Practically no Noise or Vibration.

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Power Equipment of the Frontenac Brewery, Montreal

Staff Article

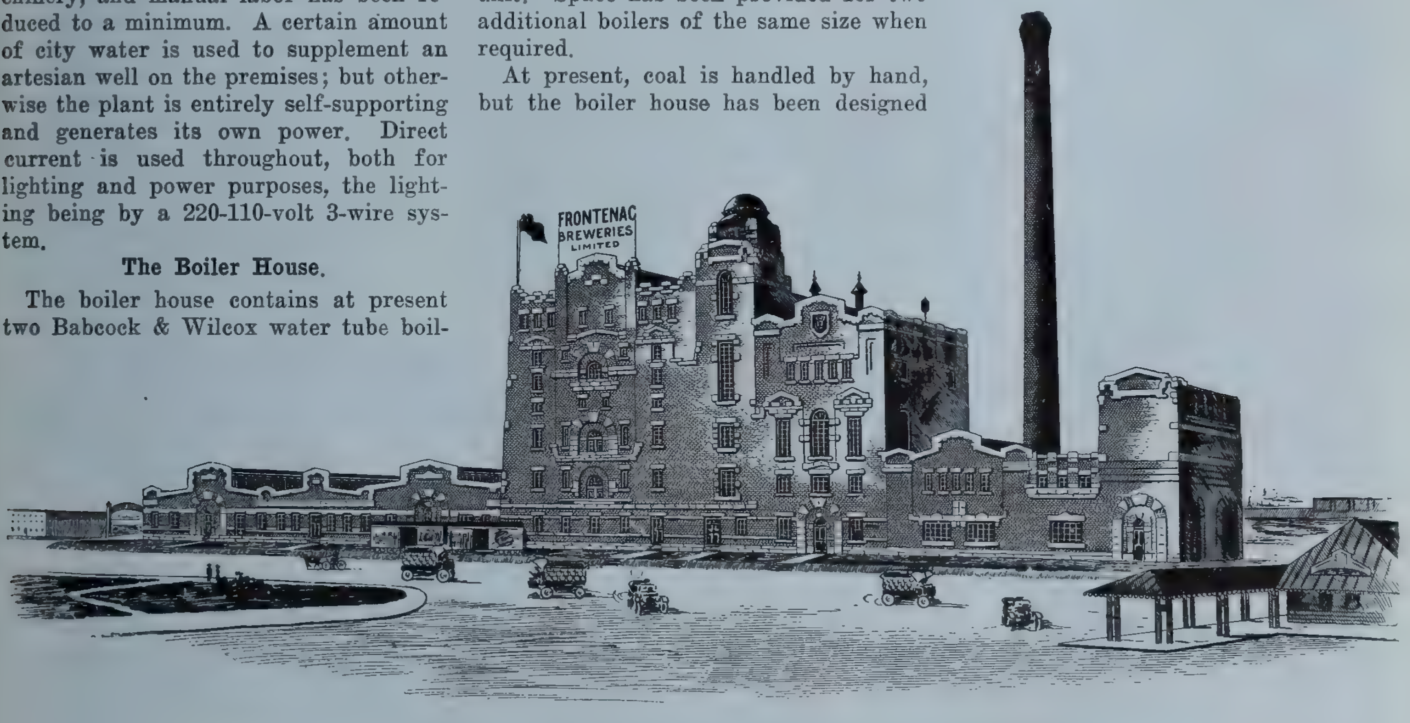
The directors of this brewery have spared neither money nor pains to secure the best and most modern equipment possible. The plant has been built on the unit system, so that enlargement to twice its present size can readily be accomplished when desired. Though not so large, it is quite as well equipped as any of the huge breweries in the United States; and the beer is produced under the most sanitary and hygienic conditions possible. The plant has been specially designed to eliminate all "lost motion," and manual labor has been reduced to a minimum by the installation of automatic machinery and other labor-saving devices.

THE plant of the Frontenac Brewery, Ltd., Montreal, which recently went into operation, is said to be the largest and most up-to-date brewery in Canada, and a visit to it paid by "The Power House" certainly served to convince one of the substantial nature of the claim.

The building stands on a site of 3½ acres at the north end of the city and was designed by Mr. Paul Ott, New York. The Canadian Stewart Co., Ltd., were the contractors for the building. The various departments all lie parallel with one another, a railway siding running across the ends of each. These departments, starting from the south end are:—Boiler House, Engine Room, Brew House, Mill House, Storage Section, Wash House, and Bottling Section. All are equipped with the latest type machinery, and manual labor has been reduced to a minimum. A certain amount of city water is used to supplement an artesian well on the premises; but otherwise the plant is entirely self-supporting and generates its own power. Direct current is used throughout, both for lighting and power purposes, the lighting being by a 220-110-volt 3-wire system.

The Boiler House.

The boiler house contains at present two Babcock & Wilcox water tube boilers of the latest forged steel construction, set in one battery. Each boiler is rated at 200 H.P. and contains 2,010 square feet of heating surface. The working pressure is 125 pounds, although the design is good for 160 lbs. They are equipped with Babcock & Wilcox patent mechanical chain grate stokers, the two stokers being driven from one 2-h.p. steam engine. Natural draft is provided by a Kellogg radial brick chimney, 150 high and 6 feet internal diameter. Practically no smoke is ever given off from the chimney, a fact which speaks well for the perfect combustion obtained with the stokers, in spite of the fact that the fuel used is soft coal slack.



GENERAL VIEW OF FRONTENAC BREWERY, MONTREAL.

The boilers are equipped with Foster superheaters, giving 100 degrees of superheat, and are covered with 2 inches of 85 per cent. magnesia insulation, this work having been done by the Canadian Asbestos Co., Ltd., Montreal, who also did all the pipe covering in the engine room. In winter, one boiler is capable of supplying all the steam required by the plant, the other forming a stand-by unit. Space has been provided for two additional boilers of the same size when required.

At present, coal is handled by hand, but the boiler house has been designed to allow of overhead bins and elevating machinery and these will eventually be installed.

The boilers are fed by two 5-7-12 Weir direct-acting feed pumps supplied through Peacock Bros., Montreal, each capable of feeding both boilers, when running at fifteen double strokes per minute. The pumps were sold under a guarantee to run as slow as four double strokes per minute without stopping. This is, of course, equivalent to a piston speed of only 8 feet per minute. The pumps are enclosed in a chamber situated in a corner of the boiler house, with the object of protecting them from grit and dust. This chamber has a roof of reinforced concrete, on top of which stands a Cochrane open-feed water heater made by the Harrison Safety Boiler Works, Philadelphia, Pa. This is connected to the main 14-inch exhaust header, and brings the feed water up to a temperature of about 210 degrees Fah. All high and low pressure drips throughout the plant are returned to the heater by Strong and Bundy traps.

The use of a Cochrane heater of this type eliminates the necessity for an independent separator for the main exhaust. A large separator forms an integral part of the heater and serves to purify all the exhaust steam brought from the engines and pumps. The heater is covered with a 2-inch layer of 85 per cent. magnesia insulation, this work having also been done by the Canadian Asbestos Co., Ltd. The main steam header above the boilers is 12 inches in diameter, and from it a 10-inch pipe leads to the engine room and a 6-inch pipe to the brew house.

The Engine Room.

On entering the engine room, which is divided from the boiler house by the usual fire wall, one is immediately struck with the extremely orderly appearance and fine finish everywhere to be seen. The various power units are painted a crimson lake color, nicely lined in gold. All steam pipe flanges and all exhaust pipes, where not covered, are painted with aluminum paint. The engine room has a Terazzo floor laid down by the Dominion Floor & Wall Tile Co., Montreal. This flooring consists of cement and colored marble chips and has a handsome appearance, combined with a smooth finish. Large windows fitted with Fenestra steel sash give the room exceptionally good natural lighting. The walls have a 5-ft. dado of white glazed tiles, above which they are painted a pale green. All engine foundations are finished off with white enameled brick and tiles, so that the general appearance of the room is very fine.

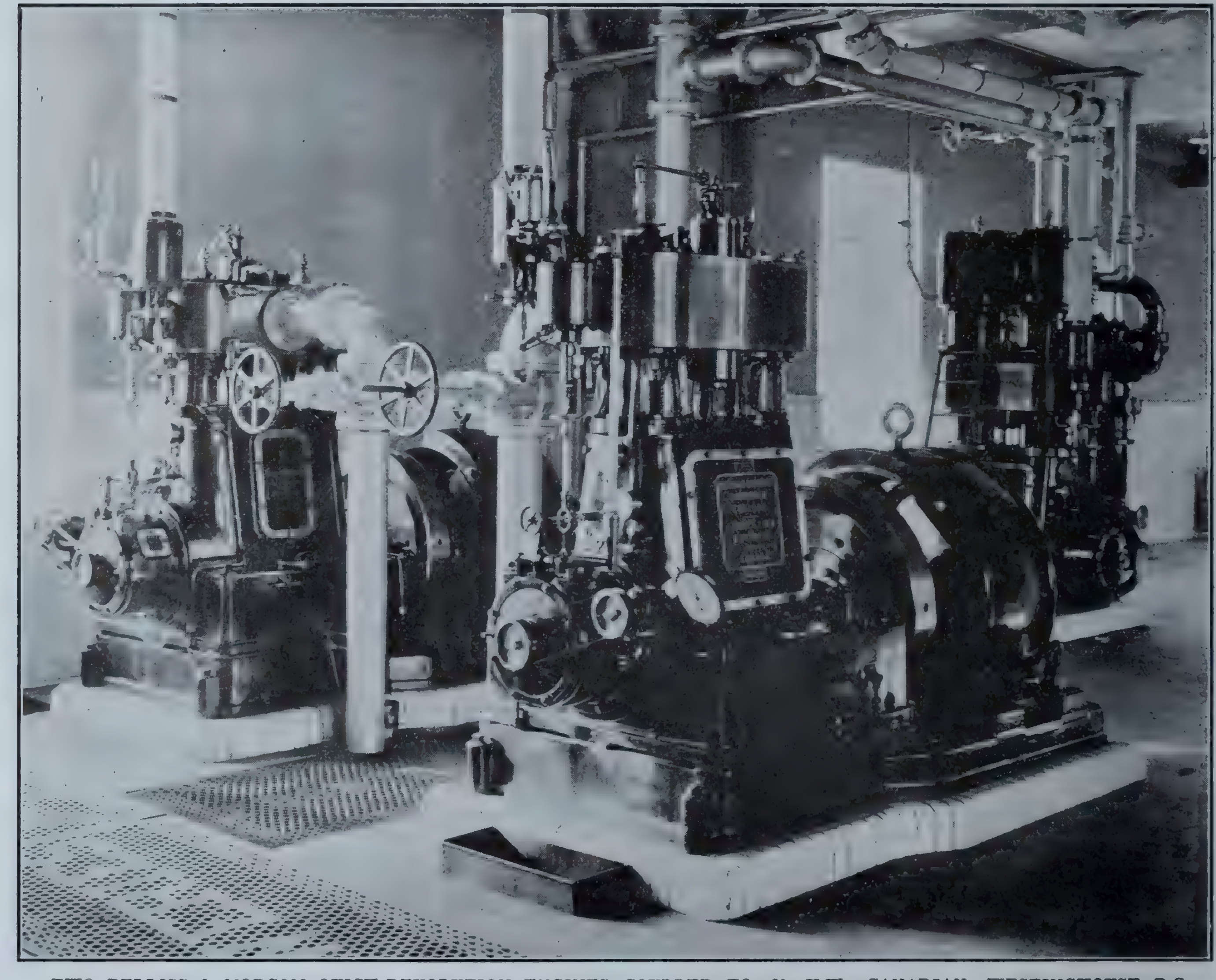
C. H. LLOYD, CHIEF ENGINEER.

Nor is it in this department only that appearances have been studied. The same high degree finish is to be found throughout the brewery, and is an excellent advertisement, as visitors can hardly fail to be impressed with the cleanly and sanitary surroundings amidst which the beer is brewed.

Refrigerating Machinery.

The refrigeration plant is an establishment in itself. This equipment was installed by the Vilter Manufacturing Company, Milwaukee, Wis., and has a total daily capacity of 280 tons of refrigeration. The two large steam-driven compressors, the ammonia condensers and the arrangement of the ammonia pipes and connections are of the latest design, and form a fine example of the progress that has been made in refrigerating machinery in the last few years.

The duplicate refrigerating units are located at the south end of the engine room. Each consists of a Vilter heavy duty ammonia compressor direct connected to a Vilter simple Corliss engine.



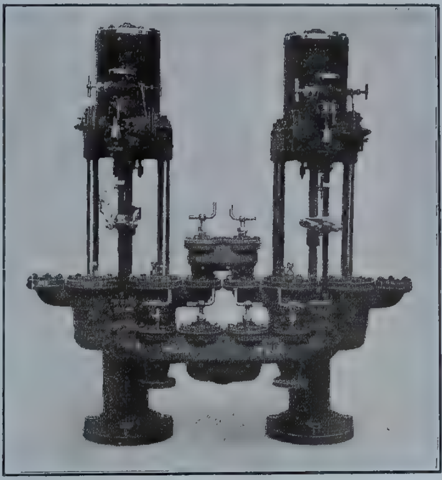
TWO BELLISS & MORCOM QUICK-REVOLUTION ENGINES COUPLED TO 60 K.W. CANADIAN WESTINGHOUSE D.C. GENERATORS.

The two units are built right and left-hand and each is rated at 140 tons capacity. In fact, when running at 60 r.p.m., with 20 lbs. suction pressure and 175 lbs. condensing pressure, each compressor delivers 142 tons of refrigeration.

The Corliss engines are of the heavy duty type with single cylinders 22 inches bore by 42 inches stroke. The cylinders are cast of a hard close-grained semi-steel mixture and are protected from heat radiation by a covering of plastic magnesia encased in neat laggings of planished steel secured by polished angle iron corner straps. The back cylinder heads are covered with highly polished false heads.

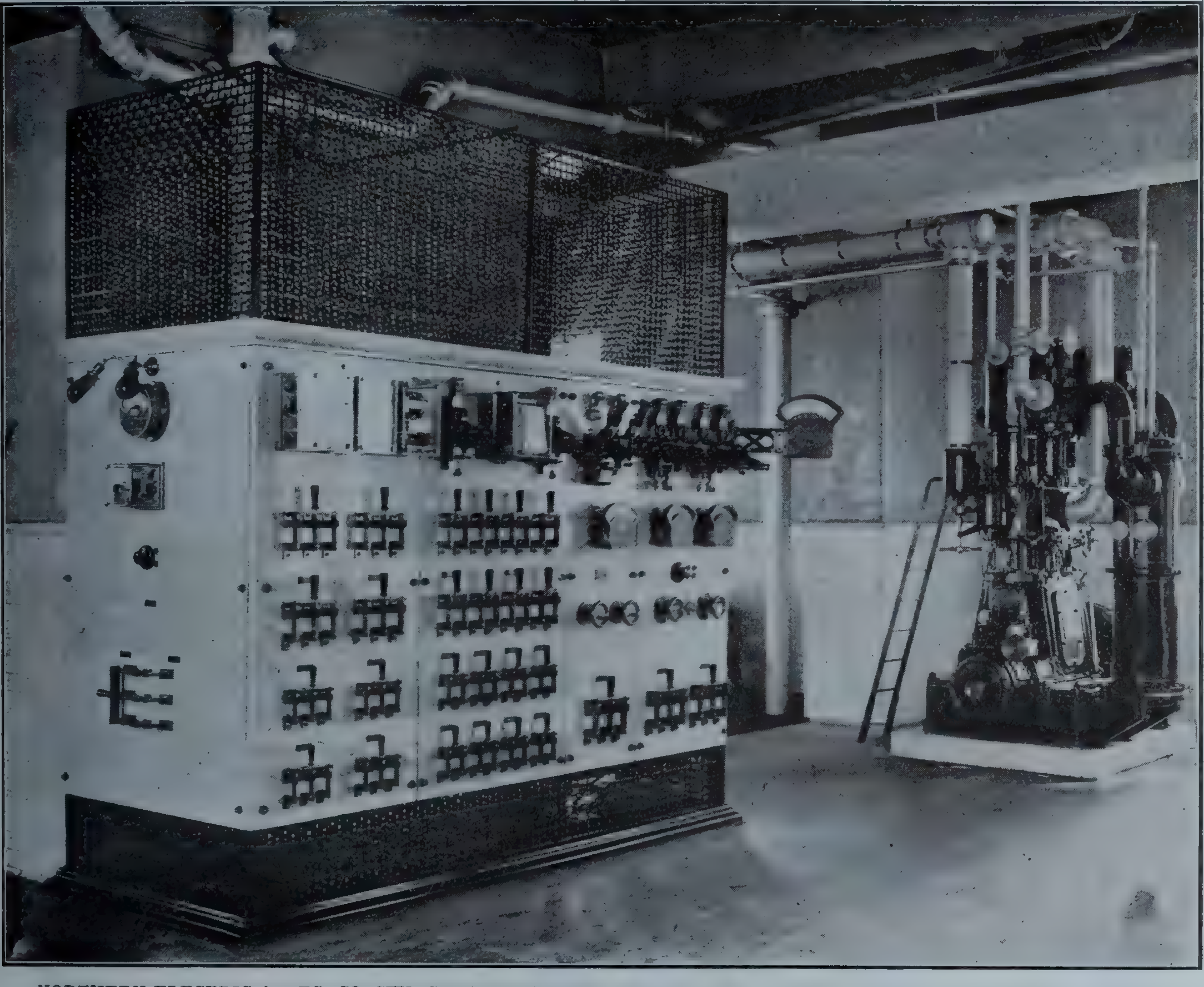
The ammonia compressors are of the horizontal double-acting heavy duty type. The compression cylinders are $17\frac{1}{2}$ inches diameter by 34 inches stroke. They are cast from a similar mixture to the steam cylinders and are pressed into the housings of the compressor frames in such a way that the latter form water jackets round each cylinder. The compressor heads are made semi-spherical, this form permitting the use of valves of large area. The valves are spring balanced and are so cushioned as to be nearly noiseless in operation. The suction valves are provided with special safety collars.

The flywheels of the two machines are made in half sections bolted together. Each wheel is 14 feet in diameter and weighs 20,000 lbs. One of the wheels has a 38-inch crowned face for a belt drive, so that the compressor may be run by an electric motor in future if desired. The foundation of this machine is all prepared for the reception of a motor, it merely being necessary to remove a rectangular brass-bound section of the engine-room floor to make room for the placing of the latter.



"WEIR" BOILER FEED PUMPS.

The ammonia condenser is of the atmospheric type and is located in a compartment above the engine room. Part of this upper room is used as a machine shop and pipe-fitters' shop. The condenser consists of a battery of eight coils, each coil being 20 pipes high by 20 feet long. The coils are constructed of 2-inch and $2\frac{1}{2}$-inch full weight wrought iron lap-welded pipe and are of special construction designed for the particular local water requirements. Each coil of the condenser is fitted with an individual shut-off valve, enabling any section to be cut out without interfering with the



NORTHERN ELECTRIC & MFG. CO. SWITCHBOARD ON THE LEFT. AND BELLISS & MORCOM HIGH-SPEED AIR COMPRESSOR ON THE RIGHT.

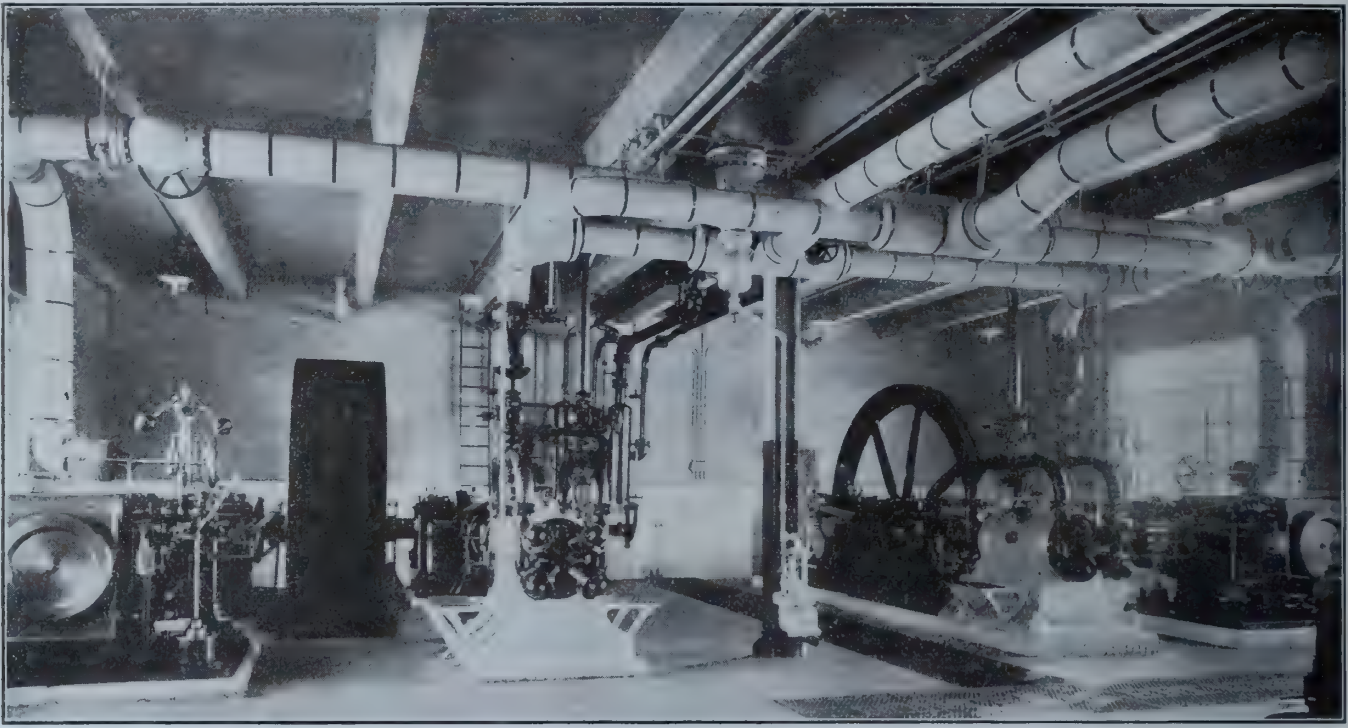
operation of the remaining coils. The condenser is of the flooded, counter-current type, the gas entering at the bottom and the liquid leaving at the extreme top. Condensing water is supplied by a motor-driven turbine pump, to be later described.

The main liquid ammonia receiver is located in the condenser room and is of the horizontal type, 20 inches in diameter by 16 feet long. It has the usual gauge glasses, valves, supports, etc., and connects with a smaller vertical receiver in the engine room. From the latter, the liquid lines run direct to the expansion coils.

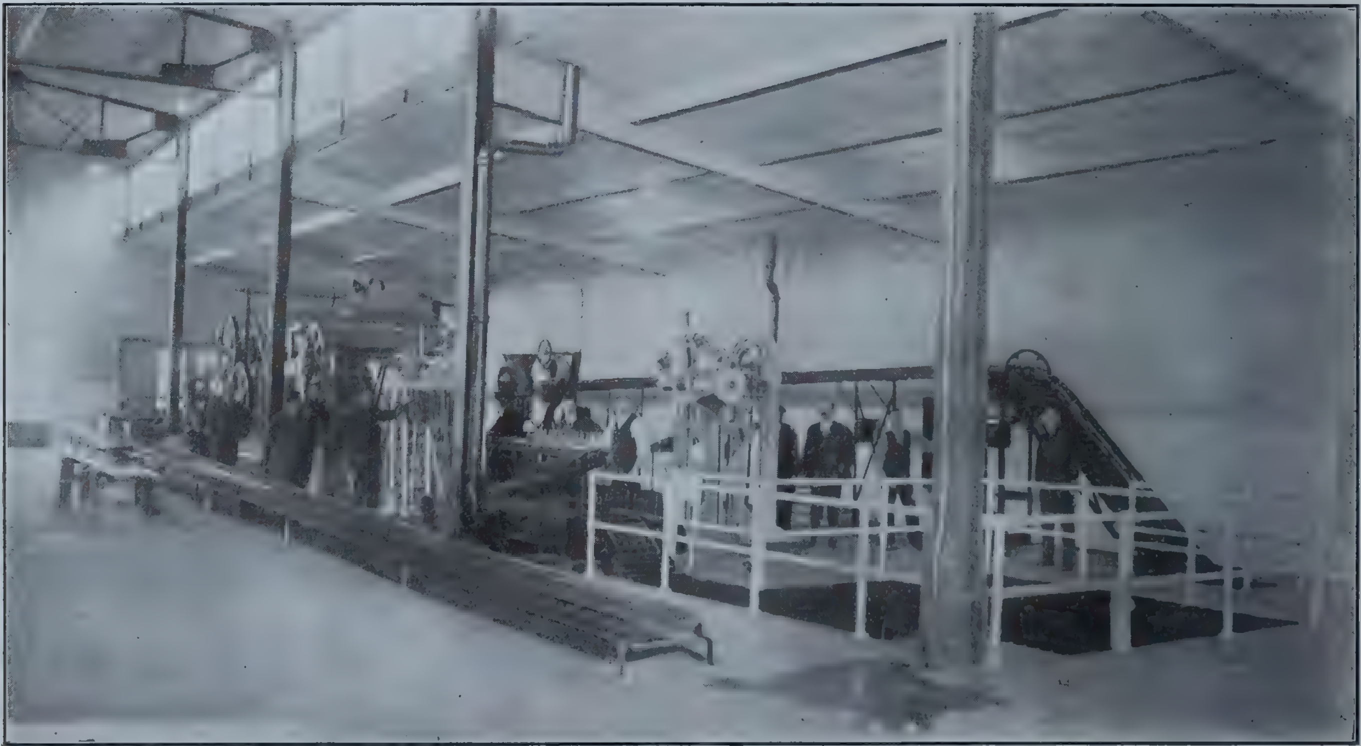
Power and Lighting Units.

For supplying current to the numerous motors throughout the brewery and for the lighting circuits, there are two direct-current units. Each consists of a 90- B.H.P. Belliss & Morcom quick-revolution compound engine, direct coupled to a 60 K.W. Canadian Westinghouse compound wound, 225-volt generator, running at 575 R.P.M. These engines were supplied under the following guarantee as to steam consumption, when using steam at 110 lbs. pressure with 90 degrees superheat and exhausting against 2 lbs. back pressure:—

At full load, 20.5 lbs. per B.H.P.
At ¾ load, 21.5 lbs. per B.H.P.



ENGINE-ROOM SHOWING THE VILTER AMMONIA COMPRESSORS.



INTERIOR OF BOTTLING DEPARTMENT.

At ½ load, 23.6 lbs. per B.H.P.

The engines are, of course, fitted with the Belliss & Morcom system of forced lubrication and also have that company's automatic expansion gear.

An artesian well, 500 feet deep, supplies most of the water used throughout the plant, and is operated by an air lift. For supplying air to the latter, there is a Belliss & Morcom vertical two-crank steam-driven air compressor, with compound steam and compound air cylinders. It has a capacity of 350 cubic feet of free air per minute compressed to 90 lbs. pressure, when running at 428 r.p.m. This compressor, in a shop test carried out by the builders, showed an overall efficiency of 4.9 cubic feet of free air compressed to 90 lbs. for each indicated horse-power developed by the steam cylinders.

Artificial lighting throughout the plant is by tungsten lights, the voltage in the 3-wire circuit being regulated by a 5-K.W. balancer set, built by the Eck Dynamo & Motor Co., Belleville, N.J.

The Switchboard.

As may be seen from the illustration, the switchboard presents a handsome appearance fully in keeping with the rest of the equipment. It was manufactured by the Northern Electric & Mfg. Co., Ltd., Montreal, and is of white marble with an ornamental electro bronze grille at top and bottom.

This switchboard differs from most in that part of the equipment is mounted on a panel at right angles to the main face of the board. This panel, which is clearly seen in the illustration, enables connection to be made with the lines of the Montreal Light, Heat and Power Company in the event of a breakdown. Of the four front panels the first one, that on the right, controls the current from the generators to the bus bars; the second controls the balancer set, while the third and fourth control the power and lighting circuits respectively. The equipment includes Weston voltmeters and ammeters, Duncan watt-hour meters for the power and lighting panels and a total load recording watt meter.

The latest types of high-grade switchboards are arranged so that no cables are exposed at the back of the panels. In most cases this is accomplished by mounting a steel pull box over the top of the board and extending the bus bars to a terminal board directly under the porcelain bushings mounted in the bottom of the pull box. It is usual to expose 12 inches of the cable as a maximum.

In the case of the switchboard under notice, the conditions were reversed and the pull box is mounted on the floor, the terminal boards being provided at the bottom of the panels instead of at the top. The generator and balancer cables extend about 12 inches from the pull box to their terminal boards, while the distance from the pull box to the feeder terminal is not more than 3 inches.

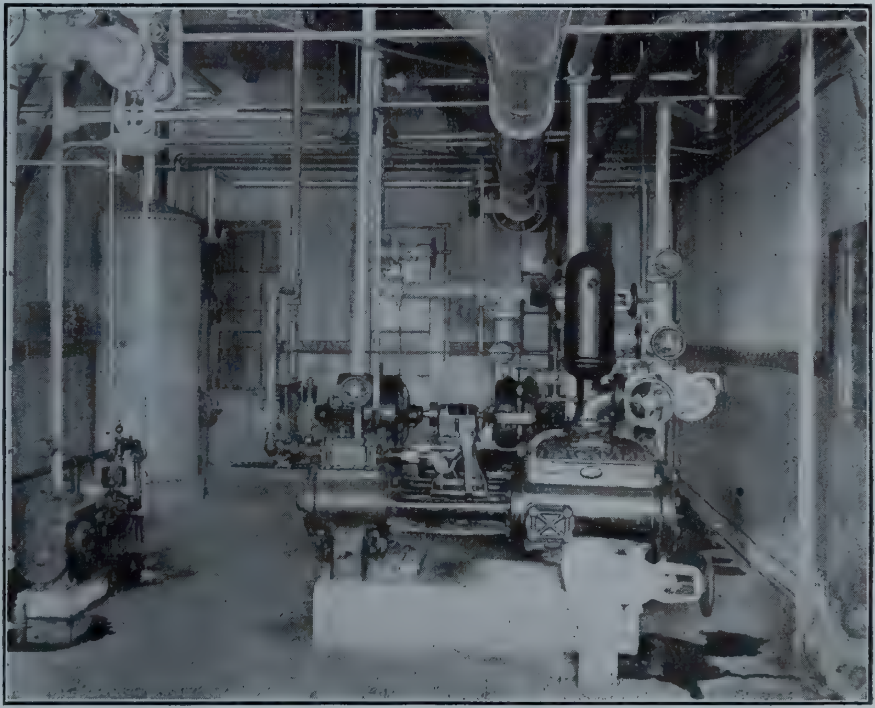
Another point of interest is found in the use of a marble cornice over the panels, and the sanitary slate base. Marble cornices have been used for a number of years; but the sanitary slate base has seldom been used in this country and the Frontenac Brewery probably possesses the first board on which this feature is to be found. It not only gives a pleasing appearance, but allows the floor to be thoroughly cleaned without filling the pull box with moisture. In the present case it raises the steel framework and the electro-bronze grille away from the floor and prevents damage from rust.

LOWER PART OF FILTER.

Pumps and Other Equipment.

At the lower end of the engine room there is a Clayton 8-in. x 8-in. single stage air compressor, operated through a short belt drive by a 10-h.p. Crocker-Wheeler motor. This compressor operates automatically, the motor being controlled by a Cutler-Hammer automatic starting panel. The output of the compressor passes through a Solar air purifier and is used for transferring beer between the different departments.

There is another Clayton compressor on the fourth floor of the brew house,



INTERIOR OF PUMP-ROOM.

outside the fermenting room. This is a two-stage, 8-4-8 machine, driven by a Link Belt Engineering Co. chain drive from a Sprague Electric Works 20-h.p. variable speed motor. The latter is controlled by a Cutler-Hammer automatic starting panel, fitted with two-speed regulation. This compressor draws the gas from the fermenters and compresses it to 250 lbs. for use in the racking room and bottling department.

Pump Room.

The water service pumps are located in a room at the north end of the engine room. As previously stated, the bulk of the water used in the plant is obtained from an artesian well, which supplies 300 gallons of water per minute at a temperature of 48 degrees Fah. The water is raised by an air lift into a concrete cistern below the pump house floor.

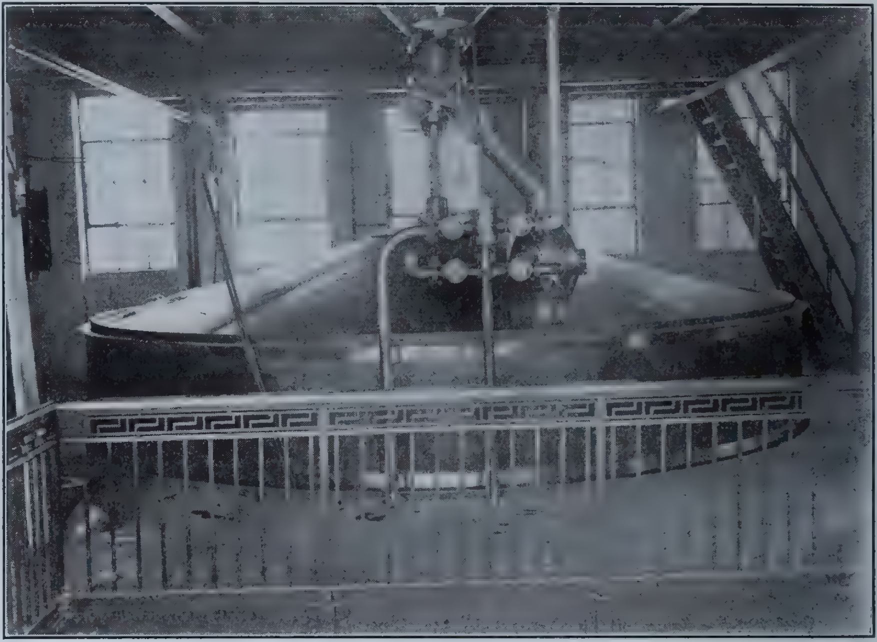
The general water service for the brewery is handled by a 300-gallon De Laval 2-stage turbine pump, direct-driven by a 25-h.p. Westinghouse compound wound motor. When this pump is not in use, water is supplied to the ammonia condensers by a 200-gallon single-stage De Laval turbine pump, direct-driven by a 4-h.p. Crocker-Wheeler shunt wound motor.

As a precaution against failure of the electric power, there is a 10-8½-10 Deane duplex steam pump. This is seen in the foreground of the illustration of the pump room. The turbine pumps are behind it, while on the left is seen the vacuum pump for dealing with the returns from the heating system, which was installed by the General Fire Extinguishing Company and operates on exhaust or live steam, as desired.

An underground concrete tunnel, 9 ft. high by 6 ft. wide, traverses the plant, and in this are carried all steam, exhaust, ammonia and water piping, together with the heating returns and lighting and power conduits.

Brewing Operations.

The product of this brewery is all lager beer of a high grade, made under the most modern and sanitary conditions. The building itself, as may be judged from the illustration, is an imposing structure. It is entirely of brick, steel and concrete, and is absolutely fireproof. The mill house in the centre of the building is five storeys in height and is topped by a cupola. The equipment in this portion of the plant includes a system of automatic conveyors which carry the malt from the receiving platform through a Richardson automatic scale supplied by Peacock Bros., Montreal, to the three malt bins, each of 5,000 bushels capacity, while another system of conveyors takes the ground malt from the mill into the brew house.

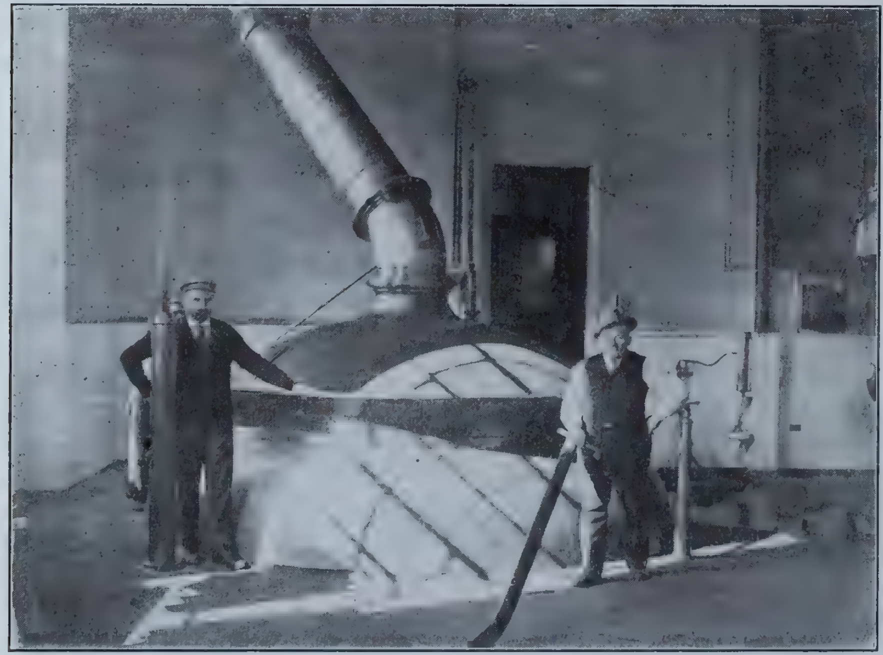


TOP OF MASH TUB.

In the latter building, there is the receiving hopper mounted on a Fairbanks hopper scale of 30,000 lbs. capacity. This is suspended over the mash tub which is 18 ft. in diameter and is operated by a 25-h.p. motor. On the floor below is the brew kettle, a copper vessel of 10,000 gallons capacity, the jacket of which is heated by live steam. The condensation is handled by a Bundy trap which returns it to the feed water heater.

On this floor too, there is the filter tub, 14 feet in diameter. Provision has been made for putting in a second kettle and filter, each of twice the capacity of those now in use. The kettle, mash tub, filter tub and two large hot water tanks in the brew house have all been lagged with 2 inches of 85 per cent. magnesia, finished with plastic cement and canvas, the work having been carried out by the Canadian Asbestos Co., Ltd.

On the bottom floor of the brew house is the hop jack, 16 feet in diameter, in which the hot wort is separated from the hops. From here the beer wort is pumped through two pipe coolers on its way to the fermenters by a 2-stage motor-driven centrifugal pump built by the Taber Pump Co., Buffalo. The motor is a 20-h.p. Crocker-Wheeler, direct-connected to the pump, and running at 2,000-2,500 r.p.m. Speed control on all variable speed motors throughout the plant is by means of field controlling rheostats.



VIEW IN BREW HOUSE, SHOWING UPPER PART OF KETTLE.

Of the two pipe coolers just mentioned, the first is a water cooler which brings the temperature of the beer wort down to that of the cooling water, and the second is an ammonia cooler in which the temperature is further reduced to that required in the fermenters—about 42 Fah.

In the fermenting room are twenty steel tanks of nearly 6,000 gallons capacity each. They are all glass enameled inside and electrically lighted. In them the beer remains during fermentation; the room being cooled by direct expansion piping.

From the fermenting room the beer passes to the storage rooms or cellars. There are two of these, each containing seventeen glass enamel-lined steel tanks of nearly 10,000 gallons capacity each. Space has been provided for twenty-four additional tanks of the same size. After remaining in these storage tanks until sufficiently aged, the beer is pumped through a filter on its way to the racking room and bottling department.

The style of keg used for draught beer is in keeping with the modern equipment everywhere in vogue throughout the plant. In place of the usual wooden barrels, galvanized steel kegs are used. These are glass enameled inside, and have a 1-inch cork lining between the steel shell and the glass enamel lining. In this way the contents of the keg are maintained at a low temperature during delivery, even on an all-day trip in the hot season. The glass lining, of course, makes the thorough cleansing of the keg an easy matter. This is done on a special keg-washing machine, an illustration of which is shown. The keg is rolled onto the cradle in front of the machine and its outside is first thoroughly scrubbed by revolving beneath the brushes. It next passes over a series of nozzles which inject a spray of high pressure water through the bung holes, thoroughly cleansing the glass enameled interiors.

The bottling department is of considerable interest, largely on account of up-to-date machinery having reduced manual labor to an absolute minimum. In the basement of this department is located the bottle-washing machine, which is served by three men only, yet can deal with nearly 6,500 bottles per hour. The cleaned bottles pass up to the bottling room by an elevator and are placed on a conveyor by one man. The conveyor passes them to the bottling and crowning machine, from whence they go to the Pasteurizer and labeling machines in the usual way. The capacity of this department is 108 bottles per minute or 6,480 bottles per hour when working at top speed. This gives an idea of the size of the Pasteurizer, through which it takes 90 minutes for the bottles to pass.

Insulation of Cellars, Etc.

The brewery cellars, fermenting room, etc., are all insulated with Nonpareil cork-board, the entire work having been carried out by the Kent Company, Ltd., Montreal. The walls all have a single 3-inch layer erected in cement and finished off with a ½-inch coat of Portland cement made with white sand to give a light appearance. In some rooms the ceilings are insulated with a single 3-inch layer of cork-board, while in others an additional 2-inch layer is put on, making 5 inches in all. The floor insulation is for the most part 4 inches thick and consists of two layers of 2-inch cork-board laid in hot asphalt.

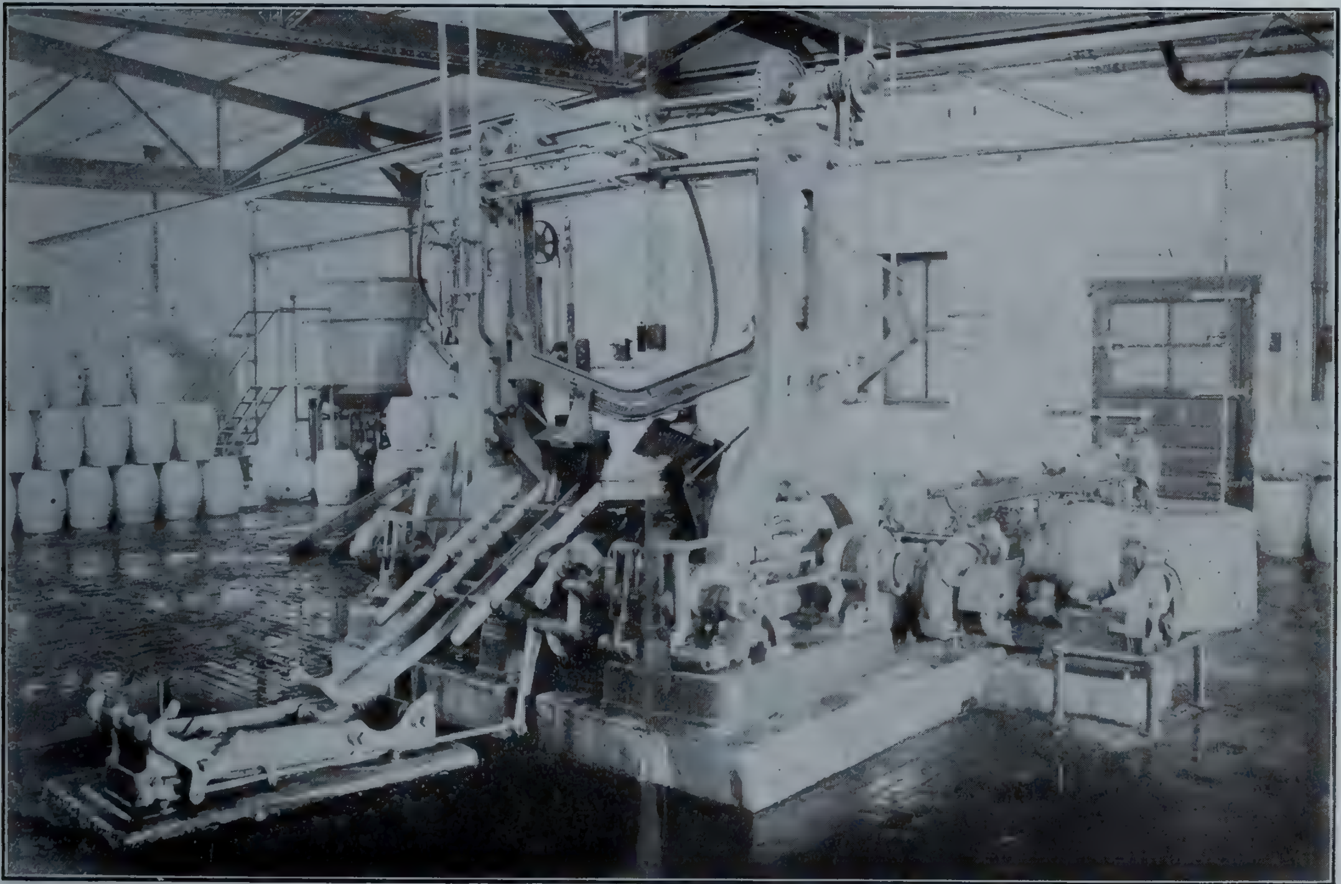
An interesting feature of this work is found in a number of partitions used to divide off some of the larger rooms. These cork-board partitions, 3 and 4 inches thick, are 24 feet high and are entirely self-supporting. They are believed to be the highest partitions of their kind ever built in Canada.

Direct Expansion Piping.

The brewery cellars are all cooled by direct expansion piping installed by the Vilter Mfg. Company. The volumes of the various rooms and the temperatures obtained are as follows:

First Floor.

Room	Cubic Feet	Deg. Fahr.
Filled keg storage	51,272	32
Racking room	16,996	32
Beer filter	5,815	32



KEG WASHING MACHINE, FRONTENAC BREWERY, MONTREAL.

Second Floor.		
Beer storage	60,700	34
Third Floor.		
Beer storage	66,484	34
Fourth Floor.		
Beer fermenting	85,100	38
Hop storage, etc.	45,365	32
Yeast room	690	32
Fifth Floor.		
Beer settling	17,890	38
Bottling House Basement.		
Bottling tank room	8,100	34
Total	358,406 cu.	feet.

The above rooms are refrigerated with a total of more than 21,000 lineal feet of 2-inch full-weight lap-welded ammonia piping divided into coils of suitable length, each coil being equipped with expansion and shut-off valves.

For cooling the attemporator tank, which is 10 ft. 6 in. diameter by 10 ft. high, there is a total of over 2,000 feet of 1¼-inch extra heavy galvanized ammonia piping made up into coils and supported on galvanized stands. All cold rooms throughout the plant are fitted with doors built by the Jones Cold Store Door Co., Hagerstown, Md.

This modern installation is understood to have shown remarkable economy in operation and is undoubtedly one of the finest examples of a refrigerating plant to be seen in the Dominion. Great pains have been taken to make everything conform to the latest brewery ideas, and all workmanship, material and design are in accordance with approved engineering practice.

Absorption Plant, Ritz-Carlton Hotel, Montreal

By H. L. Sackett *

This large hotel is equipped with a thoroughly modern absorption plant for taking care of the refrigeration and ice-making. The author points out the advantages of this type of installation, and describes the principles under which it operates. The plant has now been long enough in service to allow of an accurate judgment of its performance.

THE refrigeration plant at the Ritz-Carlton Hotel, Montreal, was installed by the Carbondale Machine Co., Carbondale, Pa., and consists of two 25-ton absorption machines, this capacity including 3½ tons of ice-making per day. The half-tones accompanying this article give an idea of the general appearance of the various units, while the line cut is introduced to enable the description of the operation of the plant to be more readily followed by those not already familiar with this system of refrigeration.

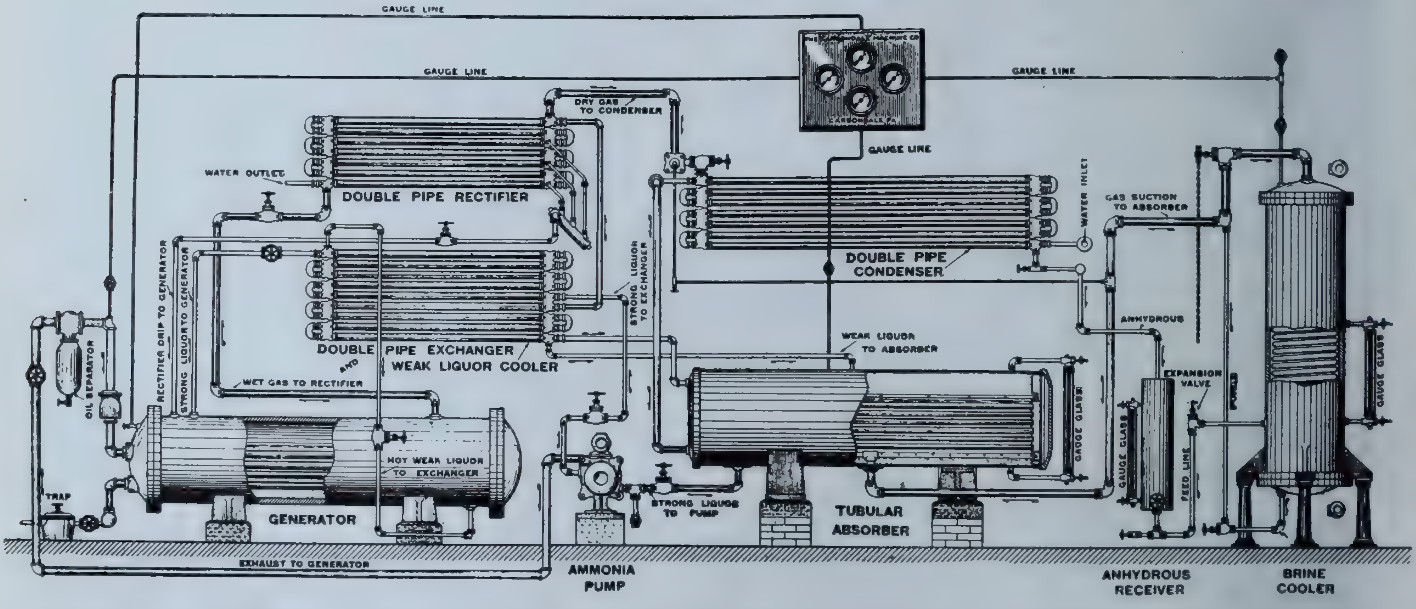


DIAGRAM OF ABSORPTION REFRIGERATING MACHINE AS INSTALLED IN THE RITZ-CARLTON HOTEL, MONTREAL.

Some of the advantages of the system may be stated as follows:—

There is practically an entire absence of moving parts and of consequent noise and vibration, since there is no compressor or steam engine. A small steam pump to deliver the ammonia liquid back to the generator is the only moving part.

In case of break-down repairs are very readily effected.

There is a great reduction in the quantity of engine room stores that have to be carried.

The steam consumption of the generators is very low.

Great economy may be effected by using the exhaust steam from the ammonia and brine pumps in the generator, using live steam to supplement it when the circulating water reaches a high temperature.

RITZ-CARLTON HOTEL.

The water consumption is low, as the same water passes through all four parts of the machine in rotation. It first enters the bottom of the condenser, from whence it passes to the absorber. It next goes to the weak liquor cooler and thence to the rectifier. During the passage of the water through the machine it has picked up several degrees of heat, which are utilized by discharging the bulk of the water into one of the hot water heaters used in connection with the hotel water service. The remainder of the water passes through a spring-loaded valve into the main suction tank to be used again for general purposes.

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*Chief Engineer, Ritz-Carlton Hotel, Montreal.

When the machine is in operation there are three distinct circulations going on simultaneously. Consider first the ammonia circuit.

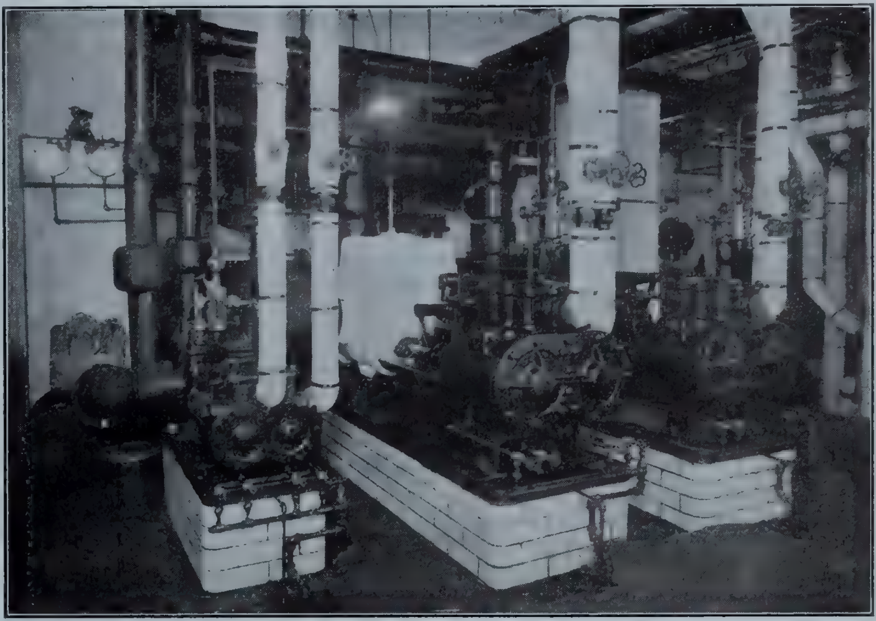
Ammonia Circuit.

The heat of the steam in the generator coils drives off ammonia gas from the ammonia liquor, which, together with a certain proportion of moisture, rises into the rectifier seen in the illustration directly above the generator. In the rectifier, the moist ammonia gas is partially cooled, the moisture being condensed and returned to the generator.

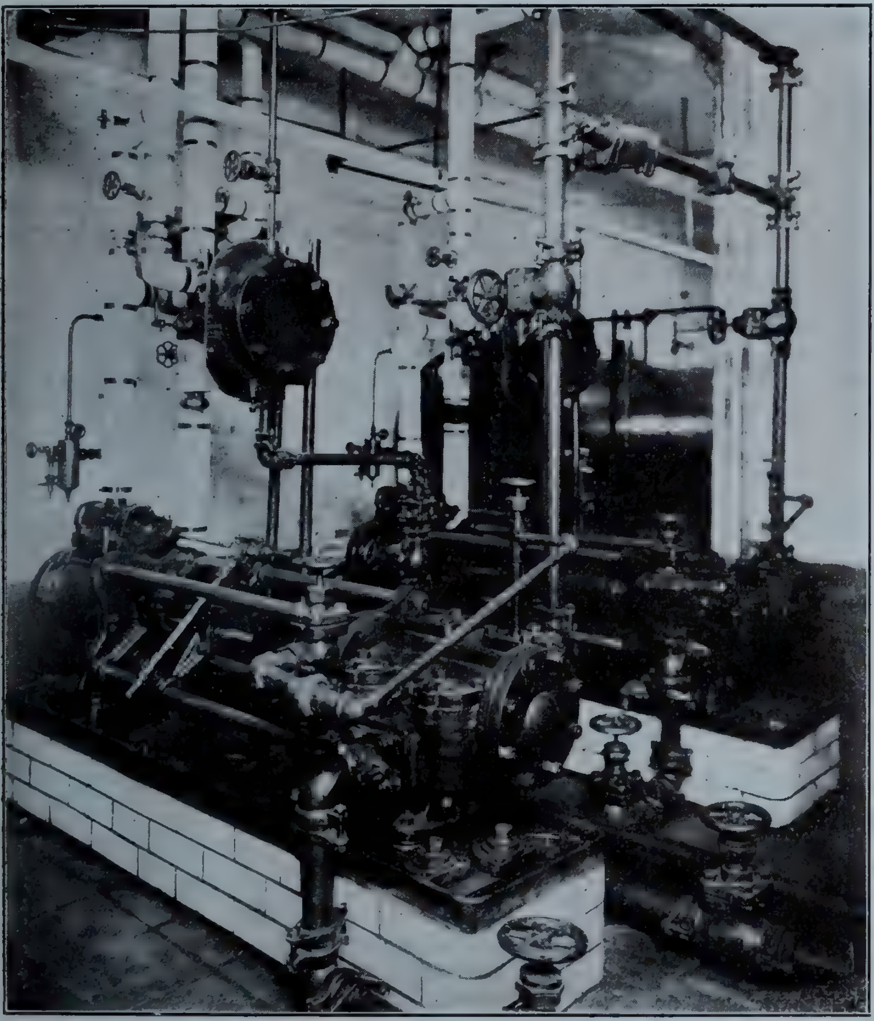
The partially cooled gas, free from moisture, then passes to the condenser where it is further cooled and liqufied after which stage it is known as liquid anhydrous ammonia. From the condenser, the liquid passes through the expansion valve into the cooler where it evaporates, producing a very low temperature. It is now, of course, in the form of gas and returns from the cooler coils into the absorber.

Weak Liquor Circuit.

The liquid left behind in the generator after the ammonia has been driven off, is the weak liquor. This passes out of the generator into a double pipe heat exchanger, where it is cooled, and then into the absorber. Here it meets and absorbs the ammonia gas coming in from the cooler.



BRINE CIRCULATING PUMPS.



AMMONIA CIRCULATING PUMPS.

Strong Liquor Circuit.

The combination of weak liquor and ammonia in the absorber is called the strong liquor. This liquor passes from the absorber when the latter is about three parts full, into the suction pipe of the ammonia pump. It is then pumped through the inner tubes of the exchanger, receiving heat from the weak liquor passing on the outside of the tubes. From the exchanger, the liquor is delivered into the generator, where the ammonia gas is once more driven off, the weak liquor settling to the bottom. The circuit is thus completed. The ammonia pump is fitted with an automatic float and valve which controls the flow to the ammonia pump according to the height of strong liquor in the absorber.

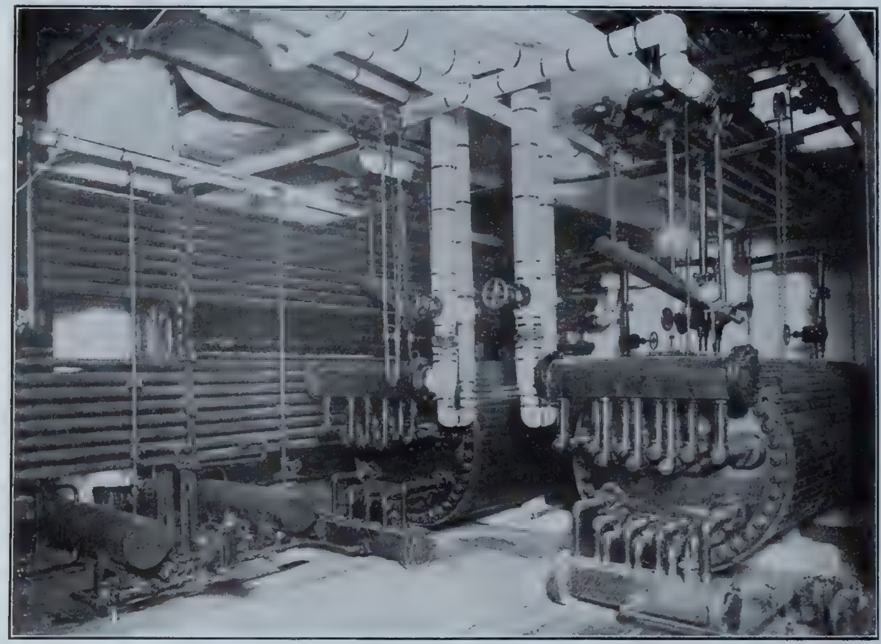
Ice-Making Plant.

The ice-making plant consists of a brine tank 14 ft. long, 8 ft. 9 in. wide and 4 ft. deep. In this, 72 cans are suspended, each containing 150 lbs. of distilled water, obtained from a single Carbondale evaporator. The return pipes of the brine system are conveniently arranged so that the circulation of brine in the tank can be increased or decreased according to the amount of ice required.

The Brine Circulating System.

The brine system consists of three Deane duplex pumps supplying a high pressure and a low pressure line. The high pressure line supplies brine to one cold storage box on each floor of the hotel, which is twelve storeys high. The low pressure line supplies all cold storage rooms and boxes in the wine cellar, kitchen, stores and bars.

During the summer months of last year, the circulating water often reached a temperature of 78 degrees Fah. and the consumption of ice was steady at 3.3 tons per day for 35 days. Notwithstanding this, one unit proved itself capable of handling the situation with ease, the other merely forming a stand-by.



GENERATORS, RECTIFIERS AND AMMONIA CONDENSERS.

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PRE-COOLING PLANT AT GRIMSBY, ONT.

THERE is being built at Grimsby, Ont., a pre-cooling plant for the Department of Agriculture, Ottawa, for cooling strawberries, peaches and similar fruits prepatory to shipment when destined for distant points. The fruit growers in the Grimsby District have been under a disadvantage when shipping fruit to long distances, such as the western markets, on account of the inadequate facilities for cooling it in a satisfactory manner during transit. The liability of the fruit being spoilt on account of the heat is great. The ordinary refrigerator car is not entirely suitable for transportation, as the heat should be extracted from the fruit before shipment. In the pre-cooling plant, however, the fruit will be thoroughly cooled before shipment and so will be kept in better condition during transit.

The building is being erected to the designs of Mr. E. J. Greenstreet, F.R.A.I.C., refrigerating engineer, Toronto, and the mechanical equipment is being made and installed by the Madison Cooper Co., Calcium, N.Y., who make a specialty of this type of plant. The building is of frame construction, two storeys and basement, and an ice house at the back extending the full width and height of the structure. A railway siding runs along one face of the building, and a shipping platform along the opposite side. The cooling plant will be on the gravity brine system. The basement will be used for the storage of fruit with a receiving and handling room in the front section. There will also be an experimental plant consisting of a coil room and a pre-cooling room, with a primary tank on the second floor. This plant will be precisely of the same type as the main plant, but independent of it and of smaller dimensions. On the main floor will be four pre-cooling rooms having a total content of 20,000 cub. ft.; also the shipping room and office.

Above the pre-cooling rooms will be the two coil rooms equipped with the requisite number of coils composed of wrought iron pipe through which circulates the calcium chloride or brine solution. Adjoining the coil rooms will be the fans and storage for cases. In the roof above the coil rooms there will be five primary tanks containing a series of coils connected with those in the coil rooms. In the tanks and around the coils a mixture of crushed ice and salt will be deposited, the proportion of salt being varied according to the temperature required in the pre-cooling rooms. Above the roof is a tower to the top of which crusher on the ground floor in the ice crusher on the ground floor in the ice house by means of a bucket elevator operated by a 3 h.p. motor. The crushed ice is delivered from the tower to the primary tanks by means of spouts. There will be a freight elevator installed by the Otis-Fensom Co., of 2,000 pound capacity for handling the fruit, etc.

In operation, the calcium chloride in the coils is cooled in the primary tanks and flows down through the coils in the coil rooms reducing the temperature of the air in these rooms. The cooled air is forced through the coil rooms by two 60-inch fans each driven by a 3 h.p. motor at 300 r. p. m., and delivered through ducts to the pre-cooling rooms. The ducts are so arranged that all the cool air can be delivered to any single room or distributed to all the rooms. The air is delivered to the underside of the false floor and rises through gratings, cooling the fruit, and is drawn off through gratings in the false ceiling to the ducts and re-circulated. The walls of the coil and pre-cooling rooms are insulated with waterproofed paper and mill shavings. On the coil room floor will be installed a 60-inch fan for ventilating the coil and pre-cooling rooms when required.

The ice house will be approximately 45 x 30 x 37 ft. high, and will have a storage capacity of about 1,200 tons of ice. There will be a bucket elevator installed for handling the crushed ice. The fans, ice crusher and other equipment are specially designed for this class of work by the Madison Cooper Co. The plant will be in operation by the beginning of the coming season, and the results will be watched with interest, for, if it be as successful as is anticipated, other plants will no doubt be built at other fruit growing centres.

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Brantford, Ont.—The Brantford Ice Co. will shortly build a new plant, and manufacture artificial ice.

Galt, Ont.—The town council has before it a proposition to install a municipal ice-making plant in connection with the waterworks system. They discussed a communication from a Montreal firm of ice-making machinery manufacturers.

Regina, Sask.—A number of prominent business men, with the backing of the Regina Board of Trade, are advocating the establishment of a municipal abattoir, with which may be connected a storage plant, curing house for hides, tannery, etc.

Edmonton, Alta.—The Triumph Ice Machine Co., Cincinnati, have just secured the contract for the refrigeration plant at the McDonald Hotel of the Grand Trunk Pacific Railway. The principal equipment will consist of two 20-ton steam-driven ammonia compressors.

The Refrigeration Plant at Bonsecours Market, Montreal

By Charles Bishop *

This Municipal Market is the only one in the Dominion provided with mechanical refrigeration, although others are about to be so equipped at Maisonneuve, Que., and Edmonton, Alta. The installation here described was put in without in any way interfering with the usual business of the market. There are between seventy and eighty stall-holders, about forty of whom are supplied with refrigeration from this plant.

SOME years back, a proposal was considered to fit a central refrigerating plant, from which the numerous tenants of the Bonsecours Market, Montreal, could secure cooling effect for their refrigerator rooms and boxes and so avoid the use of ice, which was more or less unsatisfactory as to supply, temperatures secured, trouble of loading the ice boxes which interfered with the public and tenants, and also on account of the unsanitary results secured. The City Council last year instructed the writer to prepare plans, specifications and estimates for a suitable complete refrigerating plant, and to report upon the operating expenses and name the necessary charge to the various tenants to meet the investment and overhead charges. This report was carefully considered and investigated by the city engineers and as a result the writer was instructed by the city to act as their engineer and have the plant installed.

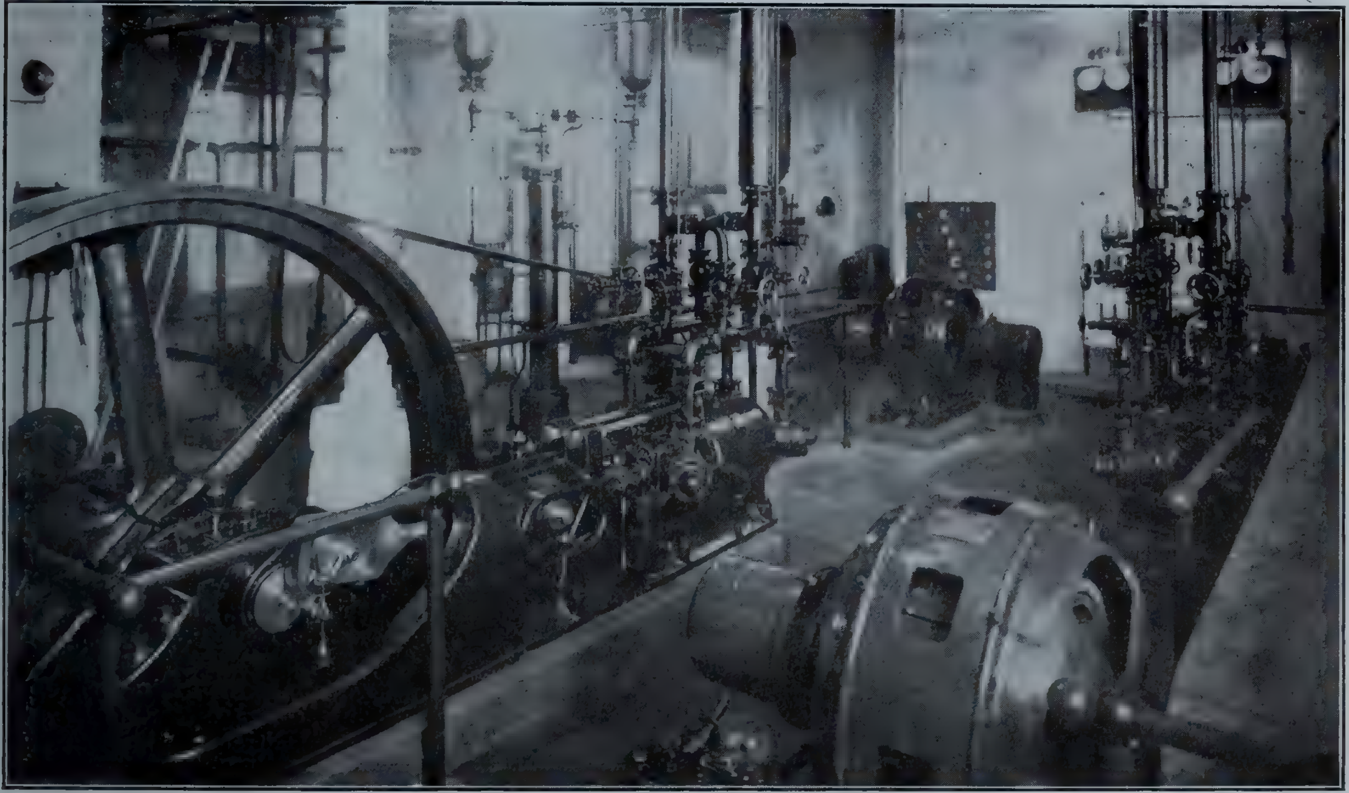
Features of the Installation.

In several details the plant is novel, as it had to be specially designed to suit very unusual conditions. In the first place, the various refrigerator rooms and boxes were existing, and had to be kept in operation for business whilst the erection of the refrigerating plant was proceeded with. The city water supply is very unreliable, being intermittent, and furthermore very expensive; the water-department charging the market department as an ordinary outside customer. Therefore, not only was water economy essential, but provision had to be made to avoid trouble from a possible shut-down of the supply for about 48 hours at any time.

Then again, by agreement with the tenants, a guaranteed temperature was offered which should not vary more than 2½ degrees Fahr. above and below the stipulated temperature. Furthermore, while there are about 40 separate tenants taking refrigeration, the supply of cooling agent was to be under individual control, yet at the same time in the hands of the engineer of the central plant. The great bulk of the work is done upon fresh meat, so that it was necessary that every cooling chamber should have full and good dry air circulation in order to obtain the best results.

As the agreement with the tenants stipulated that every precaution would be taken to safeguard against breakdown, the whole plant is in duplicate even down to the point of having two separate main power lines running to the switch-board from distinct and separate mains; so that in event of failure of one, the other source is tapped by changing over the main switch, which can be done in a few minutes. In addition to this duplication, the two plants are in all main points cross-connected, so that several main items can be cut out at will. The brine pumps are of special design to deal with the varying pressure set up by a number of tenants shutting off or opening up the brine service simultaneously. It is interesting to note that the estimates prepared many months previous to the tenders being submitted were very close. The Canadian contractors' prices were all within about 5 per cent. of the original estimates.

The plant has been in service since



TWO 50-TON YORK AMMONIA COMPRESSORS.

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*Consulting and Refrigeration Engineer, Montreal.

April 1913, and has been an unqualified success, having given full satisfaction to all concerned. During the heat wave of last summer, the one plant was capable of taking care of the maximum requirements, without any call being made upon the stand-by. Also, upon occasion, the city water supply was cut off for periods of from 24 to 48 hours, without in any manner interfering with the proper working of the plant.

The butchers' display refrigerators are on the St. Paul street level, and average about 18 ft. x 10 ft. x 9 ft. high inside with a space above, about 5 ft. high, containing the brine coils. There are also a large number of cold rooms and refrigerator chambers, as well as boxes used for butter, cheese, eggs and poultry upon the cellar level—about 10 feet below the St. Paul street level. The machinery is about 19 feet below the market floor level and the engine room opens upon Commissioners street.

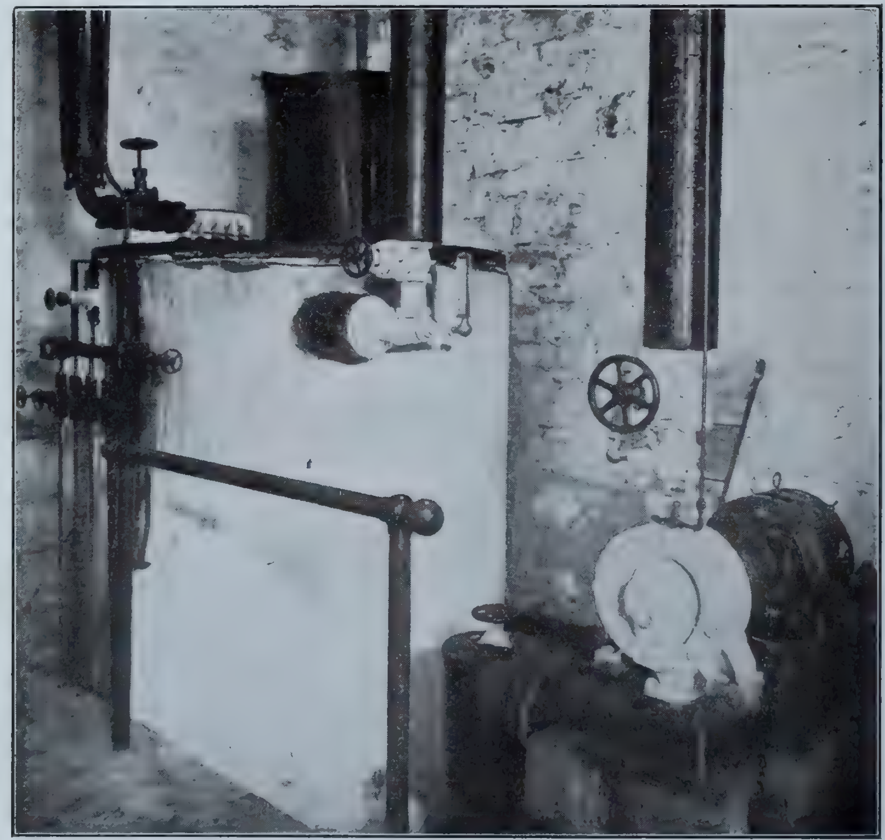
The Ammonia Compressors, Etc.

The complete contract for the refrigeration plant was awarded to the Kent Co., Ltd., Montreal. There are two horizontal double-acting York ammonia compressors, each of 30 tons refrigeration capacity at a speed of 75 r.p.m. They have heavy pulleys 10 ft. diameter by 15-inch face, taking a 14-inch belt drive direct from an electric motor. The compressor runs "in," bringing the slack side of belt on the top, without any really unnecessary jockey or tension pulleys, and with 25-ft. centres this endless leather belt drive is one of the sweetest possible. In fact one has to watch closely to make sure the belt is really running. The compressors are water-jacketed and fitted with removable liners pressed into the housing. They have solid pistons with Ramsbottom rings.

Each compressor is driven by a slip-ring induction motor taking current supplied by the Montreal Light, Heat and Power Co. Current is 550 volts, 3-phase alternating, 60 cycles. The motors are of 60 h.p. at 460 r.p.m. full load speed, but are not loaded nearly to their limit, the maximum being from 48 to 52 h.p. under full load summer conditions. Each motor has an oil-resistance starter close to the machine with a trigger release; and as the compressors have full size bye-pass and pump over connections, the starting duty upon the slip-ring motors is extremely easy. The motors were supplied by Bruce Peebles & Co., Edinburgh, Scotland.

The Condensers.

The engine room space has two recesses, each about 26 feet long by 7 ft. 6 in. wide. These are utilized for the ammonia condensers which are upon the surface evaporative system. Each condenser has four stacks of 2-inch pipes, 20 feet long by 24 pipes high, and each has a liquid ammonia receiver, 20 feet diameter by 7 feet long. The condensers are carried upon steel joists over a reinforced concrete tank 23 ft. x 6 ft., 6 in. x 6 ft. depth of water.



ONE OF THE BRINE CIRCULATING PUMPS AND BRINE TANKS.

The water over the ammonia condenser is caught in the tank and sent back in circulation by a 3-inch brass-fitted centrifugal pump. The condenser compartment is sealed and fitted with suction and delivery air ducts, and the air in the engine room is drawn by a 48-inch propeller type fan, forced over the condenser, discharged through ducts and delivered into St. Paul street at a height of about 25 feet above the sidewalk. This air circulation can be produced over either or both of the condensers together, and the same arrangement applies to the water circulating pump.

Both fan and pump are belted from a 6 h.p. Bruce Peebles motor taking 550-volt current. The water actually consumed is only that required to replace the quantity evaporated by the air current, and upon test the quantity contained in the concrete tank has been found sufficient to allow for a run of 48 hours, as before stated.

The average quantity consumed per hour for the 30-ton plant is about 280 gallons at 65 degrees Fahr., and this is let into the distributing troughs above the condenser. To provide against breaking down of the circulating pump and fan, the town water make-up pipe is large enough to give full normal quantity in case the surface evaporative system is not needed, as in winter time when the working hours are greatly reduced.

Brine Coolers and Pumps.

The brine pumps are each capable of pumping 7,980 Imperial gallons of calcium chloride brine per hour against a pressure varying from 18 to 22 lbs. per square inch, the weight of solution being 12½ lbs., per Imp. gallon. These pumps are "Rees Roturbo" patent make and, by the way, must not be confused with the ordinary turbine type of pump. The pumps are each direct-connected to a 6-h.p. Bruce Peebles motor running at 1,800 r.p.m., and under maximum conditions take about 5½ h.p. As the roturbo pump automatically adapts itself to varying conditions of head, no relief or bye-pass valve is required. In other words, the driving power remains practically a fixed quantity at a fixed speed, variation of pressure merely reducing or increasing the quantity of brine delivered. It was this very novel feature that led to their adoption for the work and they have proved exceedingly satisfactory under the hard conditions of pumping a heavy solution of calcium chloride at a temperature down to three degrees Fahr. against a fluctuating delivery head. In fact all tenants can shut off the brine supply simultaneously without any injurious effect upon the pump or its motor. The coupling has a floating connection, special insulating ferrules being also fitted around the flange studs to prevent the low temperature of the pump spindle causing condensation upon the rotor.

STALL OF GUNN'S, LTD., BONSECOURS MARKET.

These pumps are cross-connected to the two evaporators or brine coolers so that one pump can, if required, work upon both brine coolers. These brine coolers are of the submerged type and consist of steel cylindrical tanks 6 ft. 6 in. diameter by 9 ft. deep, each containing 2,250 feet of 1¼-inch continuous extra heavy welded piping arranged in five coils of equal length. The liquid is bottom fed and in order to simplify the replacing of any one coil, the bottom coil ends are passed straight through the tank bottom and made water-tight by a special split stuffing box. There is no mechanical agitator, but, by an ingenious and simple contrivance, the brine flow is utilized to give the desired effect and this method has proved a great success.

The brine coolers are thoroughly insulated with a double thickness of Nonpareil cork lagging put up in asphalt, properly banded and finally covered with about ½ inch of Portland cement plaster, neatly painted.

The Brine Mains.

The brine mains are located below the main market floor and are run upon the ring system, with lengths of heavy piping having flanged ends where necessary. They are properly insulated with heavy Nonpareil cork sectional lagging. From the mains a feed and return lead is run to each refrigerator box; or, in the case of the larger rooms fitted with several systems of piping, a lead is run to each system. These feed and return leads have each two valves, one being a master valve which is operated through a sunk fitting in the public passage of the market floor and which can only be operated by a special key possessed by the city engineer. The other valve is situated within the cold room and can only be operated by the tenant. In this manner the requisite amount of refrigerated brine necessary for each individual tenant's duty has been ascertained, and the master valve is so set. By means of the second valve the temperature can be raised if necessary by the tenant to suit his special needs or lowered to the agreed minimum, if he so desires.

The brine pipes for the butchers are placed in overhead bunker lofts originally used for the ice, and the systems of piping have been so arranged as to give the best possible amount of air circulation in the rooms below. All piping is very heavy 2-inch tubing heavily galvanized and carried on galvanized iron supports and bearers, all valves being solid brass full way type. Each system of piping is provided with the necessary pet cocks to prevent air locks.

As all the butchers' premises are above the machine room the feed mains are fitted with check valves and the return mains are provided with atmospheric stand pipes to prevent the brine leaving the brine system during any stoppage of the plant. Since the brine pumps are combined with separate motors the brine may be brought down in both brine coolers if necessary and after the refrigerating machinery is stopped, the circulating brine pump may be run alone. This flexibility helps considerably to ensure satisfactory results. For instance, in the heat of summer, during the night watch, when the market is closed and the meat, heated by the day's display, is sealed up, by reason of the cooler night hours and the sealed doors the machine gets control of the duty and brings the brine well down. With the "Roturbo" brine pump the engineer can then reduce his brine delivery, keeping pace with the work taken up and packing away the surplus negative heat in the brine coolers. When the busy market day opens, the surplus can be utilized by opening up the brine delivery, thus helping to maintain the uniform temperatures insisted upon by the tenants. The temperatures of the brine feed and return are indicated by thermometers within the engine room. The ammonia system is fitted with a Vilter regenerator and oil separator which gives full satisfaction and effectively removes all oil, etc., from the system.

In view of the rather severe comments made recently as to the backward and unsatisfactory state of Montreal's municipal affairs, it is only fair to point out that this refrigerating plant at their principal city market, after a year's hard test is a real evidence of most progressive improvement and a somewhat difficult job brought to a very satisfactory conclusion, and as the plant has proved itself against the most trying conditions and has satisfied the users, it may safely be listed as one of the good works carried out last year by the city authorities.

* * *

HOTEL REFRIGERATION AND ICE PLANT.

ALTHOUGH a refrigerating plant is recognized as part of the equipment of any new large hotel, still not all managers of hotels, using the old system of iced boxes, appreciate what a paying investment a mechanical plant can prove in their own place. The plant recently installed in the Prince George Hotel, Toronto, is a good example of a medium sized outfit, doing most successful work.

It consists of a 7½ in. x 7½ in. "York" two cylinder, vertical, single acting enclosed "Automobile" type ammonia compressor, direct connected to a vertical silde valve engine. The ammonia condenser is of the double pipe type made of 2 in. and 3 in. pipe, which is larger than standard, to allow of the water supply to the hotel from the city mains to be first by-passed through this condenser. As more water is used in the hotel for the closets, kitchen, baths, etc., than is required for the ice machine, there can be no charge made against the latter for water.

The combined brine storage and freezing tank is 13 ft. x 8 ft. x 38 inches, with bulkhead down the middle so that a higher temperature can be carried in ice freezing compartment is arranged for in which the brine coolers are located, thereby getting better quality ice. The ice freezing compartment is arranged for freezing 3,000 pounds of ice per day, part in fifty-pound moulds, and the rest in one hundred pound moulds. The ice is used for table, packing ice cream, the bar, etc. A 7⅝ x 8 x 9 Burnham steam pump is used for circulating the cold calcium brine from the tank through coolers to refrigerators and return, and there is also an auxiliary pump of the Worthington duplex type for use in case of break-down.

AMMONIA COMPRESSOR AND CONDENSER.

Both the compressor engine and pump exhaust into the hotel heating system in winter, and, in summer, this exhaust will be utilized for heating water for kitchen and hotel purposes. Accordingly, the charge against the plant for power is only nominal, because live steam has to be used in addition to this exhaust from compressor engine and pump to make up the necessary amount required for heating this water and for kitchen purposes.

BRINE TANK AND PUMPS.

A recording thermometer for brine temperature, socket thermometers, ammonia and steam gauges, give every facility for operating the plant at maximum efficiency. "Nonpareil" pure cork sheets are used for insulating the brine tank, and the same make moulded pipe covering is used for the brine and ammonia suction mains.

Besides making 3,000 pounds of ice per day, mentioned above, the plant cools by means of brine circulating coils, the following:—

Steward's Box, 16 ft. x 7 ft. x 7 ft. Temperature 34 deg.

Baker's Box, 11 ft. x 4 ft. 6 ins. x 7 ft. Temperature 40 deg.

Grill Room Pantry Box, 5 ft. 6 in. x 3 ft. 6 ins. x 6 ft. Temperature 35 deg.

Butcher's Box, 21 ft. x 6 ft. x 6 ft. 6 ins. Temperature 32 deg.

Back Bar, 30 ft. x 2 ft. x 3 ft.

All these boxes which were formerly cooled with salt and ice did not have to be altered to accommodate the new system. The saving obtained with the mechanical plant, if only the cost of ice, salt and labor is considered, is at least 80 per cent. of the first cost of plant per year.

The plant complete was furnished and installed by the Canadian Ice Machine Co., Ltd., of Toronto, and was in operation six weeks after receiving the order.

INTERESTING COLD STORAGE PLANT.

ONE of the principal features of the Wm. Davies, Ltd., Toronto, packing plant is the cold storage facilities.

The main building is 96 ft. x 65 ft., and consists of five floors, each having 55,000 cubic feet capacity of cold storage space. Each floor, again, is divided into three rooms, making a total of 15. These are used as freezers, having temperatures ranging from zero to 15 degrees, sharp freezers from zero to 10 below, and coolers from 30 to 45 degrees. The outside walls have 4-inch sheet cork, finished with a cement plaster coat. The partitions are made up entirely of 4-inch cork, and the ceilings have 2-inch cork. The roof is insulated with 5-inch cork sheeting, upon which is laid 2-ply "R. & T." felt and 3-ply "Salamander" roofing. On the floor of the basement are laid cork sheets 6-inch thick.

In another building are six hog chilling rooms with a total cubic capacity of 114,360 feet. The walls and floor are insulated with 4-inch sheet cork, while partitions are made of 4-inch cork, with cement plaster coat on each side. The roof is the same thickness and construction as the cold storage building already described. The chill rooms are equipped with a number of overhead runways for carrying hogs into the cutting-room adjoining. On the floor below the chill rooms are two freezers for general produce, maintained at a temperature of from zero to 5 degrees above, and having a total capacity of 127,800 cubic feet. The insulation consists of 4-inch cork sheets on the walls, 4-inch cork partitions, and ceilings of 3-inch cork sheeting. Adjoining the freezers is a storage room having a cubic capacity of 6,600 ft., and which is maintained at a temperature of 40 degrees Fahr. The walls and ceiling are insulated with 3-inch cork sheeting, and 4-inch material is laid on the floor. All the rooms are equipped with brine circulating pipes, the cooling being effected on the ammonia absorption system. The insulation was supplied and installed by the Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Refrigeration Equipment, Etc., Wm. Neilson, Ltd., Toronto

Staff Article

It is perhaps not generally realized that the refrigeration machinery and accessory apparatus necessary for the production of that highly appreciated and much-in-request delicacy, ice cream, fill such a large and important place in the sphere of its manufacture. A perusal of the data here given, covering a large modern and exclusive factory, will be at once convincing and instructive.

THE consumption of ice cream is increasing yearly, and every company doing a large business in this commodity requires a refrigerating plant of considerable size to take care of the demand, especially during the summer months. Hygienic considerations call for care and cleanliness in manufacture, and these conditions exist to a high degree at the factory of William Neilson, Ltd., Toronto, who have built up a large business in the production of ice cream, and latterly in that of chocolate creams.

A representative of **The Power House**, who recently visited this plant, found that manufacturing was conducted on the most approved method, under adequate sanitary conditions, and with the aid of the latest machinery and equipment. The principal products are ice cream, ice cream bricks and chocolate-covered candies of various descriptions. The processes involved in their production will be described later.

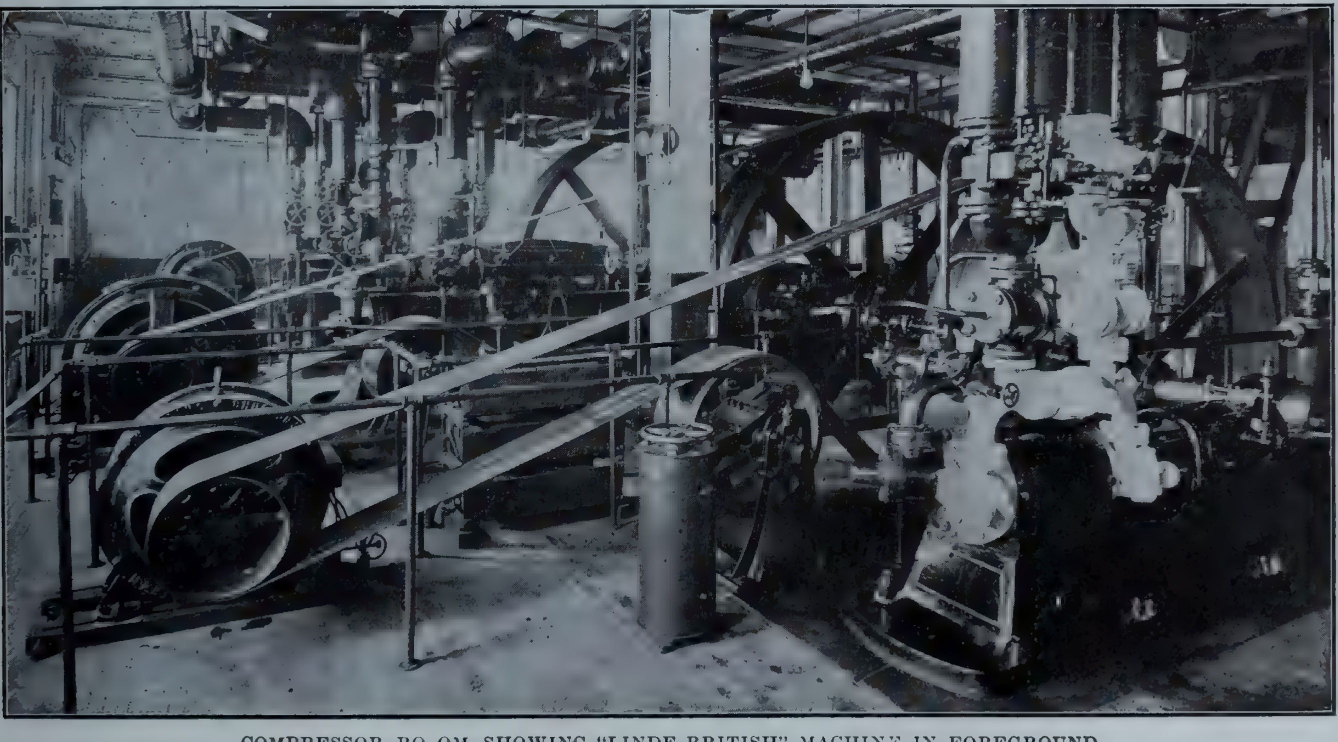
The main building is of brick construction, five storeys high, with a two-storey annex, containing the ice cream department, boiler and compressor rooms. The chocolate is made in the basement of the main building, while the offices occupy the main floor of the latter. The dipping and packing rooms are on the second floor, while on the floor above is the "centering" department, where the centre portions of the creams and similar products are made. The printing-room and stock-rooms occupy the fourth floor, and the fifth floor is devoted to the manufacture of paper boxes and cartons in which the product is shipped. In the annex on the ground floor is the shipping department, boiler-room, compressor-room, ice cream making department and freezers, while on the floor above is the can ice plant, cream-room and storage, carpenter and tinsmith shops.

The compressors and other equipment being motor-driven, steam is only required for heating and general purposes. In the boiler-room is installed a 50 h.p. return tubular boiler, 54-inch diameter and 12 feet long, supplied by Polsons Ironworks, Ltd., Toronto. The boiler feed is furnished by a duplex 4-6-6-inch pump.

Refrigerating Plant.

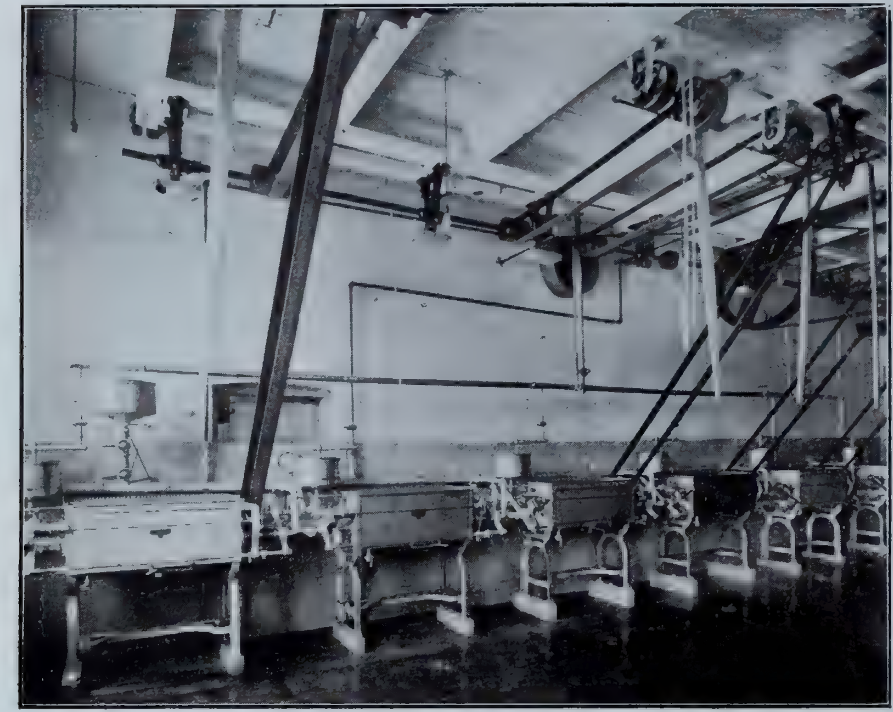
The compressor-room is about 60 x 80 feet, and contains three motor-driven, horizontal, double-acting ammonia compressors. The largest of these compressors is a 125-ton machine, built by the Creamery Package Manufacturing Co., Chicago, and installed about two years ago. It has a single cylinder, 16-in. diameter by 36-in. stroke, runs at 68 r.p.m., and is driven by a 175 h.p. C.G.E. induction motor, A.C., 550 volts, running at 500 r.p.m. The flywheel on this machine weighs approximately 16 tons. Another compressor is a 100-ton machine, with a single cylinder 16-in. diameter by 30-in. stroke, running at 62 r.p.m. This machine, installed about six years ago, was supplied by the then Linde British Refrigeration Co., Montreal, and is driven by a C.G.E. 150 h.p. induction motor, A.C., 2,000 volts, running at 500 r.p.m. The third and smallest compressor is also a then Linde British machine, installed about eight years ago. It has a capacity of 40 tons, the cylinder being 11-in. diameter by 18-in. stroke, and the r.p.m. 92. It is driven by a 60 h.p., a.c. motor of 550 volts and 720 r.p.m., supplied by the T. Harding Churton Co., Leeds, England.

All the machines have double return lines for operation with hot or cold compression when working in conjunction



COMPRESSOR RO OM, SHOWING "LINDE BRITISH" MACHINE IN FOREGROUND.

with the high and low temperature systems. They are all connected to the same piping system, the valves being so arranged that one or more machines can be out of the line when not required. The return lines are all fitted with thermometers, in order that the engineer may know if the correct amount of ammonia is passing through the system. By this means the plant can be kept under perfect control. Pressure gauges are also installed with each machine. After leaving the compressor, the gas passes through a discharge tank, which eliminates all water or oil that may have been carried over from the cylinders. The two Linde machines are equipped with rectifiers, connected up with the low pressure side, and a middle ring in the stuffing box to carry off any gas that may have escaped through the packing.



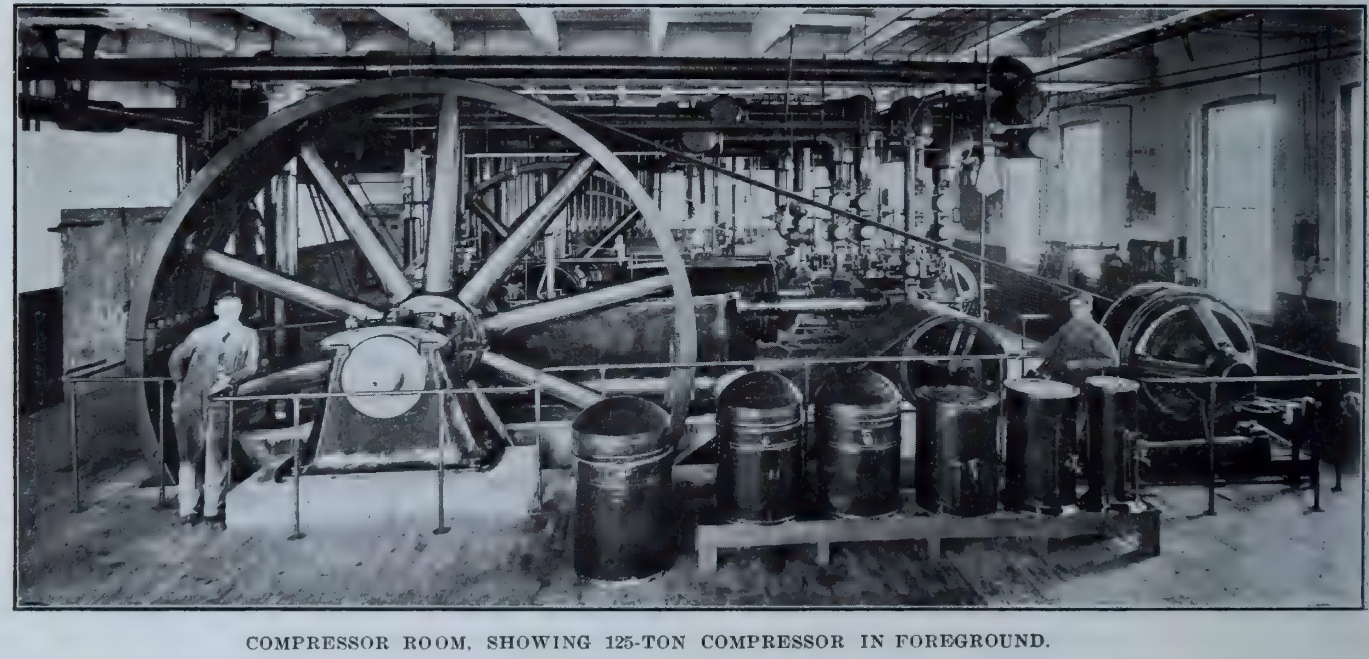
CREAM FREEZING MACHINES.

The condenser is located on the roof, and is of the double tube type, the inner or cold water pipe being 1¼-inch diameter and the outer or ammonia pipe being 2-inch diameter. The condenser is built in 17 sections, and is 18 ft. long by 18 ft. high. City water is supplied to the condenser, but in case the pressure is low, a booster pump is located in the compressor room to supply the deficiency. This is a "Smart-Turner" centrifugal belt-driven machine, with a capacity of 250 gallons per minute. The ammonia gas is pumped to the condenser at a pressure of about 150 pounds. The gas, cooling under pressure, forms a liquid which is carried down through the expansion valves in the compressor room, where the pressure is reduced to about 25 pounds in the direct expansion coils and 20 pounds in the brine tank coils. A thermometer is fitted in each line on the high pressure side of the expansion valve.

Hydro-electric current is used for driving the motors and lighting. The transformers receive current at 13,000 volts, which is stepped down to 2,000 volts for one compressor motor, to 550 volts for the other two compressr motors, and to 220 volts for the fan and pump motors. The lighting circuit carries 110 volts a.c. "Nonpareil" cork covering is used exclusively on all piping to freezing-rooms and brine tank, and was supplied by the Kent Co., Ltd., Montreal.

Can Ice Plant.

All the ice manufactured by the company is used for keeping the product cool during transit to the various stores and at the stores. The plant has a capacity of 362-400 pound cans, and consists of a large tank containing brine held at a temperature of about 14 degrees Fahr., and a number of coils containing ammonia at 20 degrees. The cans, filled with fresh water, are placed in the tank, and remain there for about 48 hours, when they are taken out by means of an air hoist attached to an overhead hand-operated traveling crane and exposed for a short period to a jet of warm water so that the ice will come away from the can readily. The process



COMPRESSOR ROOM, SHOWING 125-TON COMPRESSOR IN FOREGROUND.

consists briefly of the ammonia in the coils taking up heat from the brine, which in turn takes heat from the water in the cans, thus forming ice; the ammonia during the process becoming liquefied. Adjoining the freezing-room is an ice storage and two motor-driven ice-crushers in another room.

CENTERING DEPARTMENT, SHOWING DEPOSITORS AND MIXING KETTLES.

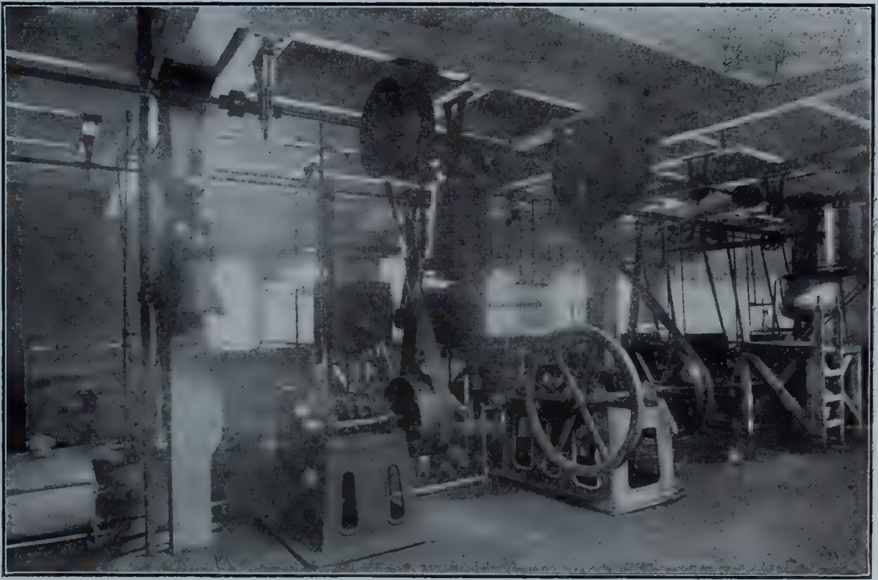
The brine tank is equipped with a propellor for agitating the brine, and air is supplied to the hoist by a "Curtis" air compressor located in the compressor-room. The machine is of the belt-driven, vertical type, single-acting, with cylinder 6-in. diameter by 8-in. stroke, and runs at 125 r.p.m.

Cooling Rooms.

In the manufacture of ice cream, cold storage rooms and freezers are essential. The can ice storage on the second floor already referred to is maintained at 32 degrees Fah. by 640 feet of direct expansion pipes. The cream storage on the same floor has a cubic capacity of 4,263 feet, and is held at 30 deg. Fah. by 600 ft. of direct expansion piping. On the main floor below, is the ice cream storage which has a cubic capacity of 9,200 feet, and is held at zero. This room is cooled by fan circulation, there being in an adjoining bunker 640 ft. of piping through which air is forced by a 36-inch "Sheldon" fan driven by a 5 h.p. motor. Adjacent is the ice cream brick storage of like capacity and temperature and cooled by the like method. On the same floor is the "brick" freezer which has 4,000 cu. ft., and is maintained at 6 degrees below zero. This room is also cooled by fan circulation, there being 2,500 feet of expansion piping and a 54-inch "Sheldon," fan driven by a 5 h.p. motor. The temperature of the storage in the chocolate dipping room on the second floor of the main building is 65 degrees. This room is cooled by fan circulation, there being 3,600 feet of expansion piping and a 70-inch motor-driven "Sheldon" fan.

Cream Room.

In the cream room the process consists of pasteurizing and homogenizing — adding the ingredients such as flavors, etc., to the cream, and mixing. The milk is first of all all pasteurized by heating in tanks shown on the left-hand of the illustration, to a temperature of 150 degrees Fahr., by means of a series of steam coils. It is then cooled in another tank to 90 degrees Fahr. The next process consists of homogenizing. This is done by passing the milk through a homogenizer, which is really a pump forcing it at a pressure of 150 pounds between the faces of a valve. This process permanently combines the contained milk and cream, thereby ensuring uniformity in the quality of the ice cream. There are two homogenizers with a capacity of 150 and 300 gallons per hour respectively. They are both belt-driven and were supplied by the Manton, Gaulin Mfg. Co., Boston, Mass. After leaving the homogenizers, the cream is first cooled by passing through a series of air-cooled coils, and afterwards into tanks containing a number of copper pipes through which brine flows; here the temperature of the cream is reduced to 36 degrees Fahr.



CREAM ROOM, SHOWING PASTEURIZERS AND HOMOGENIZERS.

The next process consists of mixing the cream and ingredients together thoroughly before being carried to the freezers. There are four mixing tanks, each containing a revolving cylinder and operated from a belt-driven shaft running along the front of the tanks. The outlet from each tank is connected to a pipe through which the cream flows to the freezers below and the piping is so arranged that any one or more tanks can be used when the others are not in service. The first mixing tank only is equipped with a cooling arrangement, which consists of a water-box at the end of the tank containing brine coils, over which water flows to the interior of the revolving cylinder. A 2-inch centrifugal pump circulates the brine through the coils in the cooling tanks. The pasteurizers, cooling and mixing tanks were supplied by the Creamery Package Mfg. Co., Chicago.

Cream Freezing.

The cream freezers, "brick" freezing rooms and cream storage are located together on the main floor. There are six freezers, having a total capacity of 600 gallons per hour. In each freezer are two revolving coolers containing brine at 6 degrees Fahr., and connected with a brine system, circulation being provided by a 2-inch centrifugal pump. The cream from the mixing tanks on the floor above flows down direct to the freezers, from which it is drawn off when it has reached the proper consistency. The cream for the bricks is drawn off into shallow trays and placed in the brick freezer where the temperature is 6 degrees below zero. The freezers were supplied by the Creamery Package Mfg. Co. The bulk storage and brick freezer rooms are insulated with 6-inch "Nonpareil" cork and are equipped with "Stevenson" doors.

The brick-cutting room is on the main floor near the freezing room. Here the blocks are cut in a brick-cutter, 32 bricks being made at one operation. The bricks pass along a table where they are wrapped and put on a belt conveyor which runs over another table over which is a carton or box hopper. The boxes come down a chute from the box-making room into the hopper. The bricks are next packed in the boxes and sent to the shipping room.

Chocolate Making.

The various departments and processes which have been already described are all connected with the refrigerating end of the plant. The remaining departments while of considerable importance from a manufacturing standpoint are not so closely allied to the refrigerating plant as the others, therefore a brief description will only be given of these.

The most interesting section from a mechanical standpoint, apart from those already described, is perhaps that devoted to the manufacture of chocolate. The machinery is of the latest type and represents a considerable outlay. The greater number of the machines were supplied by the J. M. Lehmann Co., New York and Paris. A large quantity of chocolate is used, and this calls for a plant of sufficiently large dimensions to take care of the demand. This department is located in the basement of the main building, the location being readily determined by the pleasant aroma emanating from it.

The cocoa beans are imported from the West Indies and other countries. The beans are first of all cleaned in a special machine, then roasted and cracked. They are next ground in mills to a fine powder after which the ingredients are added. The mixture then passes through two refining mills and finally is worked up into a thick paste in a "conche" machine, when it is ready for the dipping-room. There is also installed a sugar pulverizer. The machinery in this department is driven by a 50 h.p. Can. Westinghouse a. c. motor.

The "centering" department is on the third floor and is where the cream centres are made. The ingredients are mixed together in steam-heated mixing kettles, the cream being further treated in a cream beater. Moulds for the reception of the various mixtures are made in starch laid on wooden racks, the impressions being made in the starch by plaster of Paris patterns also arranged on wooden racks. A machine called a depositor having been filled up with cream or other mixture, the moulds are placed underneath and the cream poured into them. When the creams have set, they, together with the racks, are put into a "starch buck" where separation takes place, the creams being carried to the dipping room on the floor below. In the dipping-room, the creams are covered with the chocolate and laid in the cooling room to set. They are then carried to the packing room and prepared for shipment.

The Company make their own paper boxes and labels. On the fifth floor is installed machinery for making the boxes and cartons and for fixing the labels. On the floor below, the labels are printed and made to the required shape and design. Part of this floor is used as a stockroom. A Turnbull elevator, with a capacity of 2,000 pounds and motor-driven, serves all the floors, and a fire protection system is installed throughout, while lavatories, and other comforts and conveniences conducing to the welfare of the employees, who number 275, are provided on each departmental floor. The ice cream output in summer amounts to 6,000 gallons per day, and in winter, when the demand is naturally less, the average is about 400 gallons per day. The management and direction of the factory is vested in the following officers:—

William Neilson, president.

Morden Neilson, manager and secretary.

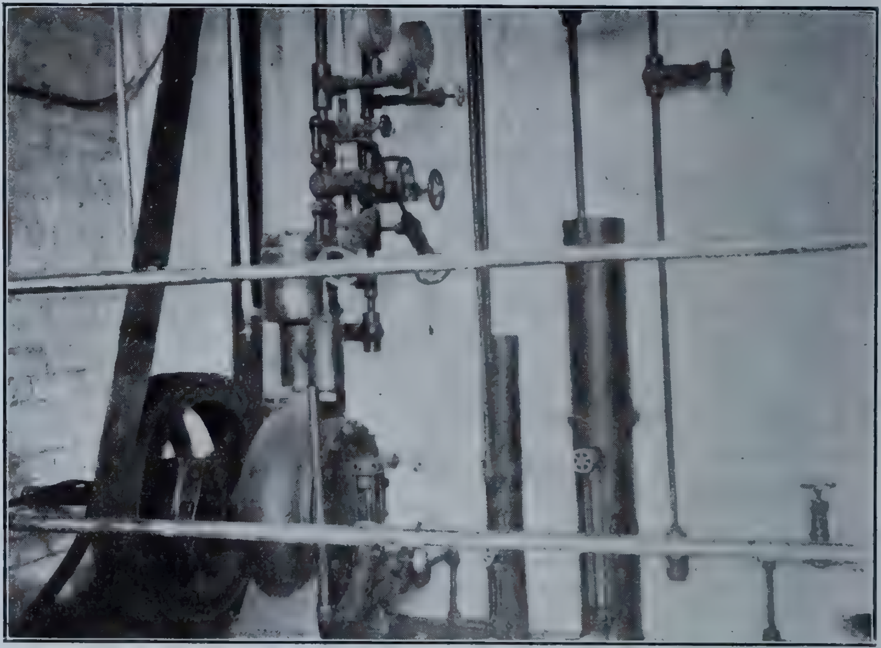
Allen Neilson, superintendent.

D. Madill is chief engineer.

MODERN DAIRY INSTALLATION.

THE illustration shows a 1-ton "Brunswick" ammonia compressor installed at the Wm. Muir dairy, West Toronto, for cooling a milk storage and brine system for a milk pasteurizer. The machine is of the vertical, single acting type with enclosed crank case and oil splash lubrication. It is equipped with ammonia receiver, oil separator, expansion valve, and scale trap on suction side for retaining any scale or dirt, etc., that might get into the system. The valves and pipe joints are ground metal to metal, and the discharge valve is the full diameter of the cylinder. The compressor is driven by a 2½ h.p. motor situated on the top of the cooling room.

The condenser is fixed to the wall above the compressor and is of the double pipe type, water cooled, and connected to the high pressure side. The low pressure side is connected to a set of direct expansion coils located in the cooling room. On the wall of this room is a brine tank of flat construction, containing a series of coils for cooling the brine. This arrangement maintains the temperature of the room when the compresor is not working. On the top of the cooling room is another brine tank containing a series of coils connected with the direct expansion piping. The brine from this tank is pumped through the coils in the pasteurizer in order to cool the milk after being pasteurized. The cooling room construction consists of 4-inch "Nonpareil" cork-board, with cement plaster coat on both sides. The compressor and other equipment was supplied by W. A. Drummond Co., Toronto.



ONE-TON BRUNSWICK COMPRESSOR, WM. MUIR DAIRY.

BOILER EXPLOSION AT OTTAWA.

A DISASTROUS boiler explosion occurred on the morning of January 21 at the Howick Hall, Ottawa, when three men were killed, five severely injured, and several valuable horses perished. The Eastern Ontario Live Stock Show was being held at the time, which accounts for the presence of the horses. The hall is a steel and concrete structure, with an annex, about 150 yards square at one end, built of wood. It was under this section that the boiler and heating plant were located.

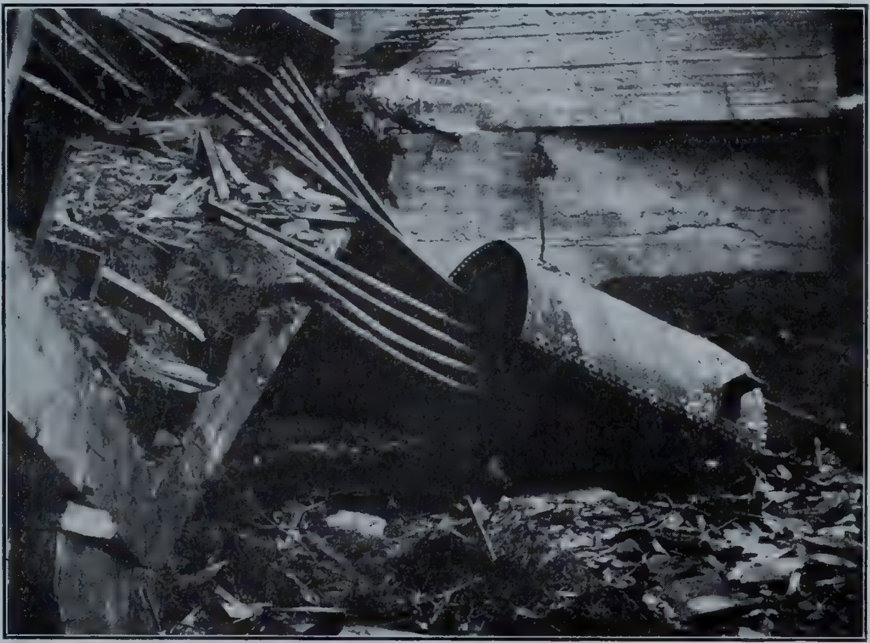
The boiler was of the return tubular type, 60-inch diameter by 14 fet long, and had 82 3-inch tubes. It was made of Carnegie steel plate of 60,000 T.S., 5-16-inch thick, the heads being ⅜-inch thick with 1⅛-inch longitudinal stays. The longitudinal seams had double riveted lap joints with ¾-inch rivets, 2⅞-inch pitch. The girth seam was a single-riveted lap joint having ¾-inch rivets, 2 1-16 inch pitch. The safety valve was of the lever and ball type, 3½-inch diameter. The boiler failed at the manhole ring, which was of cast iron, and through the front shell plate in a longitudinal direction.

At the official enquiry, held to investigate the cause of the explosion, the jury brought in a verdict to the effect, "that the explosion was caused by excessive steam pressure and that the safety valve and steam gauge were defective." According to the specification, the boiler was good for 65 pounds working pressure, but it had been operated at a lower pressure, usually around 20 pounds, and was used for supplying steam to a low pressure heating system. We are indebted to Mr. D. M. Medcalf, chief boiler inspector of the Province of Ontario, for the constructional details and accompanying photographs. Mr. Medcalf made an examination of the wrecked boiler on behalf of the Provincial Government.

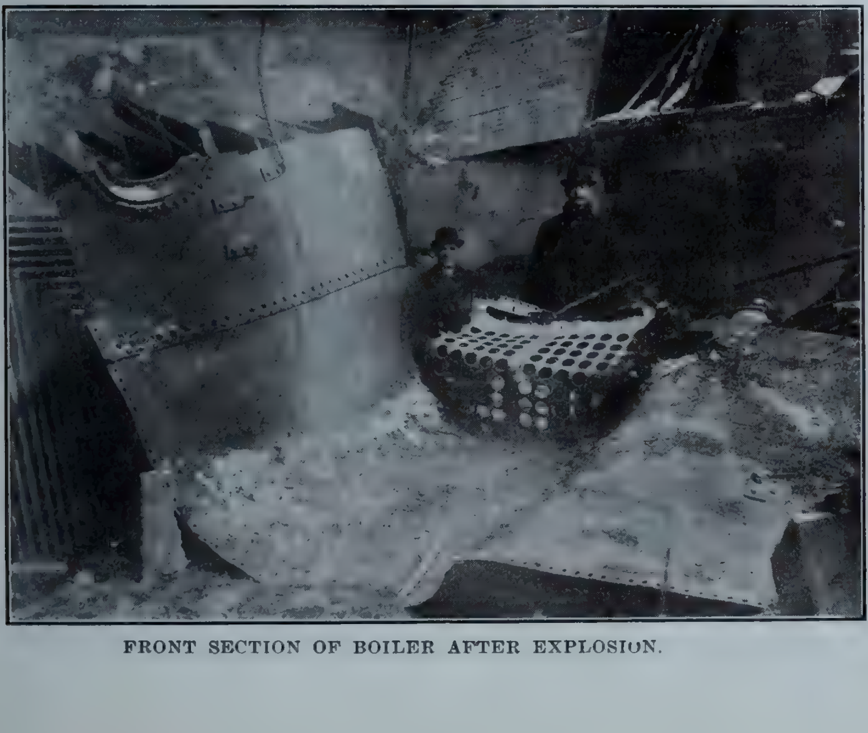
THE WEATHERING OF COAL.

MUCH has been written on the weathering of coal, says a writer in the Power User, and generally speaking it has not borne out the complaints that are made as to the capacity of weathered coal for steam raising. There are several actions at work when coal is weathered.

First, there is the actual contact of the atmosphere. When coal becomes hot in a pile it is because it is being slowly oxydized, and there is not sufficient cooling at work to keep down the temperature. Now, if coal can oxydize in this manner it is being destroyed as coal. Probably in a closely-packed heap a very small amount of heat will produce a considerable temperature, for the heat is locked in, and all accumulates until a high temperature is attained. Then, if air be admitted, the heap may fire. Some deterioration must have occurred, for a coal cannot be twice oxydized, and once it has been hot some of its calorific value has passed off. It is said also that once coal has become hot in the heap and has cooled down, it will not again become hot. It would thus appear that there may be some principle in coal which is specially ready to oxydize, that its amount is small, and that once having heated there is none left to repeat the process.


REAR SECTION OF BOILER AFTER EXPLOSION.

In recent years it has been observed that coal dredged up from salt water, where it has lain many years, is quite uninjured. It has been kept cold, away from contact with air, and has not been knocked about, and, we believe, steps have been taken to provide under-water storage for coal at the coaling stations of the Navy. A further advantage is that such coal ceases to be a grimy nuisance as soon as it is submerged, and also that it is effectively fenced against all possibility of fire. Various reports and papers have appeared in different publications on the weathering, heating and storing of coal but, at the moment the writer cannot locate these. Coal is probably a very complex substance, but very little is known of its actual constitution. It can be analyzed for its ultimate elementary constituents—so much carbon, hydrogen, sulphur, oxygen, nitro-


FRONT SECTION OF BOILER AFTER EXPLOSION.

gen, so much silica and alumina, and small quantities of iron and other elements. If distilled at a high temperature, it will give off a certain number of products, compounds of the foregoing elements. If distilled at a low temperature, a different set of compounds are given off, but it cannot be said even that these are present in the coal. Rather they are present out of the coal.

It is not known how the atoms of the chief constituents are bound together. The products of distillation are apparently formed in the process of distillation, for if they were in the coal in the same chemical combination in which they are distilled off, the same compounds would come off at different temperatures. Thus we know more of the plant and animals of which coal was formed ages ago, than we know of its chemical constitution to-day. We do know that compounded with a very little hydrogen, carbon ceases to be a very infusible substance and becomes gaseous, liquid or plastic, and all these states of carbon may be obtained if coal be heated; but coal at ordinary temperature exhibits no trace of such other states of carbon. It is, therefore, not easy to trace the results of weathering, of slow or partial oxidation. The mere fact that mechanically coal is so very friable, especially some of the highest qualities of it, should, however, be sufficient to make it imperative to avoid as far as possible both roughness of mechanical treatment and exposure to atmospheric influences.

RUNNING DIESEL OIL ENGINES.

IN the event of a Diesel type engine not running properly, says the Engineering Review, the cause or causes should be investigated without delay; and the following information will be found of considerable service in showing how defects may be remedied.

If, after starting-up on air and the fuel oil is admitted to the engine, firing does not occur, it should be ascertained whether:—

(a)—The fuel filter cock is open.

(b)—There is enough oil in the nozzle.

(c)—The fuel pump contains air, discovered by bubbles rising on disconnection of the delivery pipe.

(d)—The fuel pump valves are loose, or their seats corroded.

(e)—The exhaust or intake valve-cages are loose, preventing the necessary rise in cylinder air-pressure.

(f)—The oil fuel fails to flow through the pipes, due to excesive viscosity.

(g)—Water has found its way into the fuel oil.

(h)—The suction valve is loose, discovered by applying pressure from the air injector bottle.

It should particularly be observed that, although on disconnection of the delivery pipe the fuel pump may deliver against atmospheric pressure, it may be incapable of supplying oil under the pressure of injection. Knocking is caused by (a)—the pressure of the injection air being too high; (b)—the needle in the fuel nozzle being loose on its face; or (c)—the orifice in the flame disc being too wide.

Should an exhaust valve not lift easily, observe whether the spring is broken; or whether the seating is corroded with carbon or soot. In the latter case, a very small quantity of paraffin may be used to free the spindle and guide.

A smoking exhaust indicates that:—

(a)—There is overloading.

(b)—The fuel oil is unsuitable.

(c)—The air pressure for injection is insufficient.

(d)—The starting, air, or exhaust valves are loose.

(e)—The needle of the fuel nozzle is loose, the pulverizer is dirty, or the orifice in the flame disc is choked.

(f)—The piston head is dirty.

When the governor motion is excessive or irregular, then the dash-pot piston jambs, the control rods are prevented from working easily, or the valves of the fuel pump are loose.

Defective working of the air-compressor pumps may be due to:—

(a)—The valves being dirty or loose.

(b)—Foreign matter in the inter-coolers.

(c)—The piston rings sticking from lack of lubricant, or being rusty from the presence of water in the inter-coolers.

(d)—Excessive clearance in the air chamber.

Partial loss of pressure in the air bottles may be in consequence of defective valves, or their not being screwed down tightly enough. Should complete loss of air pressure occur, the motor may be started on carbonic acid gas. Great care must be taken in this operation that all connections are in order, and all valves are ready to work properly. The vessel which holds the carbonic acid is set close to the starting bottle, and a suitable pipe fixed on to the unions provided for the purpose on these bottles. If it be found that the pressure in the injection bottle is less than that in the starting bottle, supply the injection bottle from the starting bottle first, and before the valve of the latter is opened for the admission of the carbonic acid.

Stoppage of the motor may be caused by:—

(a)—Partial or complete cessation in the fuel feed.

(b)—Water in the fuel oil.

(c)—Jambing of the exhaust valves.

(d)—Overload.

(e)—Seizing of the air compressor piston from lack of lubricant.

(f)—Seizing of a main bearing from insufficient oil, manifested by the absence of crank oscillation on stopping.

Where a compressor of the Reavell type is employed, it is necessary that the mechanism be kept scrupulously clean, and lubricating oil of good quality be used. Indifferent lubricant is extremely liable to stick the piston rings, so that much of the air pressure escapes. Moreover, the air volume may be rendered insufficient in consequence of foreign matter or carbon on the faces of the valves and their seatings. Unless a full body of water be maintained in circulation, rapid heating will occur, thus causing carbon deposit which will affect proper compression.

Should a rise of pressure take place in the intermediate receiver, the high pressure or delivery valves must be examined for leakage. This operation is effected by opening the drain cock on the intermediate purge pot and allowing full pressure to enter from the air tank above the high-pressure delivery valve.

(a)—If air escape from the cock, then the high-pressure intake and delivery valves are both leaking, but, even though no air escapes, one of these valves may be loose, because, if one of them seats correctly, that is alone sufficient to stop a leak into the intermediate purge pot.

(b)—By removing the high-pressure delivery valve, replacing the cap, and re-admitting the pressure to the high-pressure cylinder, the defective valve may be discovered. Leakage in the high-pressure intake valve is shown by air escaping from the drain-cock of the intermediate receiver; and should the valve be tight, air must be admitted behind the delivery valve, after removal of the intake valve, from the seat of which air will escape if the delivery valve is leaking. The same methods are applicable in the event of pressure increase in the low-pressure receiver, and these are effected between the low-pressure and the intermediate cylinders, the high-pressure intake and delivery valves being detached. For testing, the air pressure should not exceed approximately 100 lb. in the low-pressure reciver, and 400 lb. in the intermediate chamber.

◆

Ottawa, Ont.—The Board of Control has appointed G. E. Sims, Montreal, to prepare plans for the erection of a municipal abattoir, for which it is proposed to erect a two-storey concrete and brick building, with capacity for 50 cattle, 75 hogs, and 110 sheep. The city will issue debentures for $100,000 to provide for its erection and equipment.

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THE BUSINESS OUTLOOK.

TO all appearance the business depression in Canada struck bottom some time since, if we might judge by the reports of improving tone in the machinery and allied trades. Easier money conditions now prevail, and what is perhaps the most potent feature of all, people generally have become optimists. As remarked on a previous occasion when the descent was still in progress, everybody was lending their weight to accelerate it, and as becomes human nature, all hands are now engaged in the elevating process.

The development and progress of Canada, dependent though it be to a large extent on conditions in other countries must go on, and in this connection there is just the possibility that more of the financial assistance so generously received from Great Britain will this year be forthcoming, if, as is generally believed, the crest of the wave of industrial prosperity there was reached in the closing months of 1913.

◆

ARITHMETIC FOR MECHANICS AND ENGINEERS.

BEGINNING with the present issue of **The Power House**, and accompanying each month the **Questions and Answers for Engineers**, a course of lessons in **Workshop Arithmetic** will be given, and in order that it may have the fullest scope, the subject matter will be treated right from the foundation upwards.

Arithmetic in the workshop, factory and power plant is to-day perhaps a more necessary requirement than at any previous period of industrial history and enterprise, and conducing as it does to the cultivation of a sharp and clear intellect, in addition to facilitating and systematically contributing to high degree quantity and quality production, as well as to the advancement of the individual, there is no reason why beneficial results should not follow the study of each lesson, even by those who have got beyond what will be the necessarily introductory part.

◆

TENSION ON CYLINDER COVER STUDS.

THE article which appeared on pages 21 and 22 of our January issue, entitled **Tension on Cylinder Cover Studs**, appears to have touched a responsive chord in the heart and head of quite a large circle of the readers of **The Power House**. We say heart as well as head because of the large number of expressed opinions received for publication, it being a well-known fact that timidity or want of heart courage has been and is robbing the pages of technical journals by retaining in more or less obscurity a myriad forms of high degree inventive genius with its resultant accomplishment. We refrain from making comment meantime on the particular question under discussion, it being sufficient as well as gratifying to know that given the opportunity to cultivate and develop their beings along the line of higher grade intelligence, most men will quit the groove of the automaton.

There is an impelling attractiveness and fascination in analyzing and figuring out problems involving more or less arithmetical calculation, and even although in some cases there may be an unconscious disposition to read into them more than is really involved, the ultimate results are all on the credit side. The features, however, that make study of this nature more valuable are the knowledge that a collective intelligence is being concentrated on the work of each individual, and that a corresponding benefit thereby accrues. There is absolutely no necessity for an operator harboring uncertainty in his mind, at this time of the day, as to the why, wherefore and proof of design and detail of mechanical engineering construction, and if a little more heart—pluck if you like—were brought to support the head, by readers bringing their difficulties and problems out into the open so that others could join in and help the originator and themselves, the standard of operative ability would be materially raised, and greater achievement of the craft would be made easily possible.

Another set of readers' opinions on the problem will appear in our March issue, lack of space limiting the publication of all of those received in the present instance.

◆

Claiming to be, and being what is claimed, usually are two different things. No man who measures up to his claims need say anything, it will be apparent.

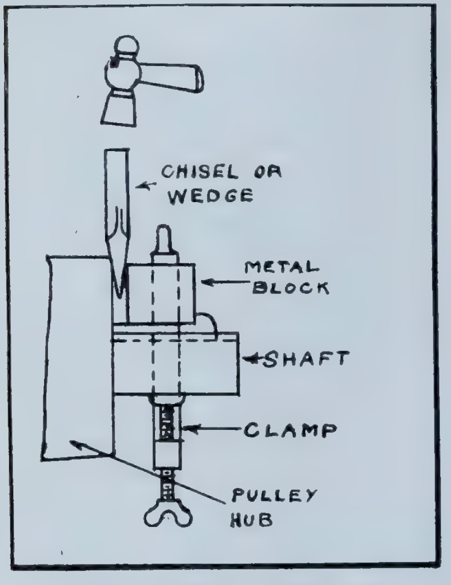
THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

HOW TO PULL A TIGHT KEY.

By N. G. Near.

THERE is shown herewith a little scheme that I have found useful for pulling tight keys. The drawing makes the operation self-evident. The metal block is thicker than necessary in order to show the method more clearly. It is, in fact, better to use a thinner block thus making the overturning movement less. Of course the exact arrangement illustrated need not always be strictly followed, there being a hundred and one variations based on the same principle.



HOW TO PULL A TIGHT KEY.

* * *

TENSION ON CYLINDER COVER STUDS.

By A. E. W.

IN the January issue of **The Power House** there appeared an article under the above heading, by J. H. Rodgers, in which the old question is raised of whether the tension in cylinder cover studs is increased when steam is admitted to the cylinder.

It is generally agreed that with a metal-to-metal joint no increase in the tension on the studs takes place until the force tending to separate the cover from the flange exceeds the initial tension in the studs due to the screwing up of the nuts. If, on the other hand, an elastic packing be inserted in the joint, the tension on the studs is equal to the initial or "screwing-up" tension, plus the tension due to the steam pressure. This second conclusion is correctly arrived at by Mr. Rodgers, and is illustrated by his Fig. 8. His Fig. 1 also shows conditions as they are, but he makes the mistake of saying that if the weight on the cover were only 10 lbs., the stress on the studs would be 1,005 lbs.

In order to secure a steam-tight joint it is, of course, necessary that the cover and flange be made thick and rigid. When the cover and flange are pressed together, metal-to-metal, they are much more unyielding than the studs or bolts. If the flange and cover are assumed to be so heavy and rigid that they cannot be compressed at all, the studs are practically springs, and, in order to produce in them a tension higher than the initial tension, a force must be applied to the cover sufficient to separate the latter from the flange.

Referring to the accompanying Fig. 1, let it be assumed that each nut is screwed up so tight that its stud is elongated 1-1,000 inch, and, in order to use the same figures assumed by Mr. Rodgers, we will suppose that this elongation produces a stress of 1,000 lbs. in each stud. The cover is thus pressed upon the flange with a force of 1,000 lbs. for each stud. Only two studs, as seen in the figure, need be considered. We have then a force of 2,000 lbs. holding the cover to the flange.

If a weight of 800 lbs., as shown at (A), be now placed on the cover, it is obvious that no extra stress is set up in the studs. For they cannot be stressed beyond 1,000 lbs. without being at the same time further elongated, and they cannot be further elongated unless we separate the cover from the flange, to do which will require a force of slightly over 2,000 lbs. The only effect of the weight (A) is to reduce the pressure between the cover and the flange by 800 lbs. If, however, the weight (A) be increased to 2,000 lbs., the studs will be stretched a further 1-1,000 inch, and the joint will open. This result has been embodied in the following rule:—

When the bolt, or stud, is more elastic than the material it compresses, the stress in the bolt is either the initial stress or the force applied, whichever is the greater.

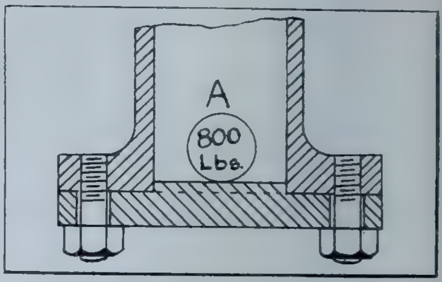


FIG. 1. TENSION ON CYLINDER COVER STUDS.

The Elastic Joint.

Next consider the conditions existing when a packing or gasket is introduced at the joint, as shown at (B), Fig. 2. In such a case, it is the packing rather than the stud that is elastic. Let us assume that the studs are again stressed to 1,000 lbs. each, and that this compresses the packing 1-100 inch. If now the weight (C) of 800 lbs., as before, be applied, the studs will be stretched an inappreciable amount compared with the amount the packing has been compressed. The result is that the packing will be pressed against the flange with practically the same force as before, and the only effect of the weight (C) is to increase the stress in each of the studs by 400 lbs. In other words, the stress in the studs is the initial stress, plus the

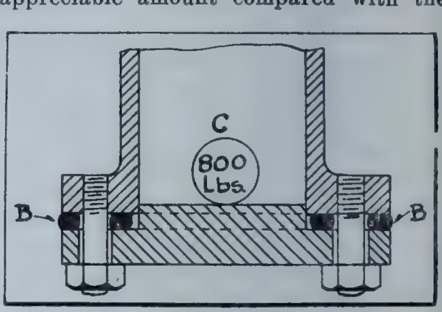


FIG. 2. TENSION ON CYLINDER COVER STUDS.

stress due to the force tending to separate the cover from the flange. Hence the second rule:—

When the material compressed is more elastic than the stud, the stress in the stud is the sum of the initial stress and the force applied.

◆

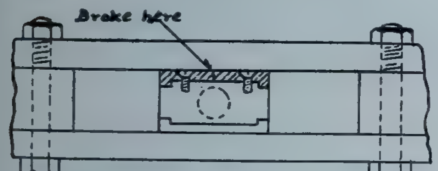
REPLACING CROSSHEAD LINER.

By R. Bell.

ON an engine of the double bar type there were brass liners fixed to each side of the crosshead shoes. These were secured by means of ⅝-in. countersunk headed screws, and further held in place by a shoulder at each end as shown in sketch. One of these liners got working loose, and eventually broke in the middle, so it had to be replaced, being unsafe. A very quick and effective repair was made as follows.

The top guide bar was taken off and the liner removed. The guide block was cleaned properly and then replaced. The engine was next turned over until the crosshead stood in the narrowest part of the guide bars, these being worn a little in the centre. The open edges were then boxed up with wood and all small spaces filled with clay, provision being made for a runner to allow the babbitt to be poured in. The space formerly occupied by the liner was now filled with babbitt, boxing removed, a liberal supply of valve oil applied to the guide bar and the engine started up. The result was a first-class job started and completed during the lunch hour.

I am of the opinion that babbitt might be used more extensively than it is for repairs such as the above-mentioned. It makes a substantial and satisfactory job, does away with all machining.

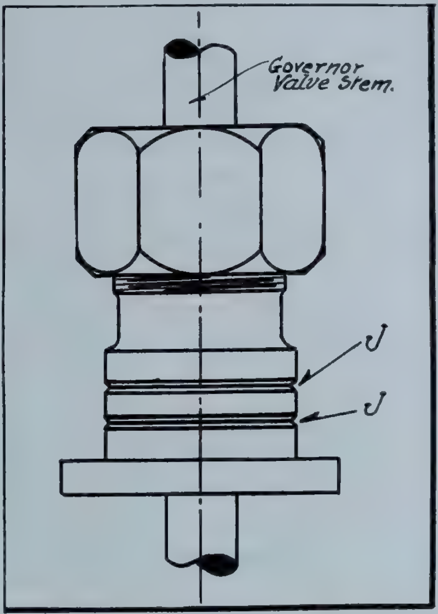


◆

LEAKY STUFFING BOX REMEDY.

By J. E. McCormick.

ON an old engine, the governor spindle stuffing box had been turned to tightly fit into the hole drilled for it in the top of the governor valve chamber and had been thus forced into place, but after long service it had become so loose as to develop a disagreeable leak. I remedied the latter by cutting two grooves as indicated in the sketch. As a small ridge was formed on each side of each groove, it increased the diameter between these points, and by going lightly at first and frequently trying it in place, a snug fit was easily secured at both grooves and the part again forced into place. By fitting and finishing the lower groove first, I was able to fit each groove independent of the other.



LEAKY STUFFING BOX REMEDY.

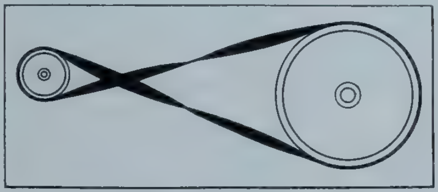
This repair was made three years ago, and although no lead or other substance was used, there has been no leaking since. I believe this method of "expanding" may be adapted to some other items of repair work where a tight fit is required in a joint requiring no movement between the parts.

◆

RUNNING A CROSSED BELT.

By J. E. McCormack.

WHEN running a crossed belt on two pulleys, one of which is only one-third, more or less, the diameter of the larger pulley, try putting the belt on the smaller pulley first; then, after crossing it, turn the remaining loop inside out, other side to the pulley, before placing it on the latter. This belt will now scrub its edges less than if put on in the usual manner. Of course, as one side comes in contact with one pulley and the other side comes in contact with the other pulley the joint must be laced or fastened accordingly. The foregoing method will not apply when the difference in the pulley diameters is comparatively small.



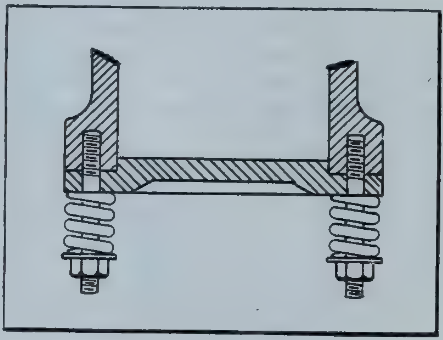
RUNNING A CROSSED BELT.

STRAIN ON CYLINDER HEAD STUDS.

By H. Westwood.

AS this is a question about which there ought not to be any difference of opinion among engineers, and as there is some danger that some who ought to understand it, may not consider it worth their while to figure it out, I beg to submit the following explanation:—

Assume that ten studs securing a cylinder head to the cylinder are long enough to permit a heavy coil spring on each one in such a way that one end of it will press against the outside of the cylinder head, and the other end against a washer placed between it and the nut on the stud. If the nuts be now screwed up, so that each spring is under a tension of say 1,000 lbs., there will be a total pressure of 10,000 lbs. against the head tending to hold it up to the end of the cylinder. As the springs will exert an equal pressure in both directions, there must be a tension of 10,000 lbs. on the studs. It will now be readily understood that all the strain there is on the studs is that due to the action of the springs, and that this cannot be increased except by further compression of the springs. This can be done from the inside of the cylinder by turning on the steam and as soon as the pressure rises in the cylinder there is certainly more stress on the studs by further compression of the springs, thereby forcing the head away from the cylinder and shortening the distance between the cylinder head and the washers under the units.



STRAIN ON CYLINDER HEAD STUDS.

To those who find this proof convincing, it may be well to suggest that the part performed by the springs in this particular case is ordinarily taken by the elasticity of the studs which act precisely in the same manner, and it may be well to say further that the above action in regard to bolt strains, is not confined to cylinder head bolts only, but is true in all cases where a bolt or a stud is subjected to tensile strain.

◆

Flywheel Query.—H. Westwood, Stratford, Ont., has sent in the following problem for solution by readers:—A flywheel 12 ft. in diameter, and weighing 10 tons, revolves at a speed of 150 r.p.m. It is built in halves, these being secured by four 2½ in. bolts at the hub, and by four 2-in. bolts at the rim. If there is a tensile strain of 1,000 pounds on each of the hub bolts and 700 pounds on each of the rim bolts when the engine is standing, how much strain is there on the respective bolts when the engine is running at normal speed?

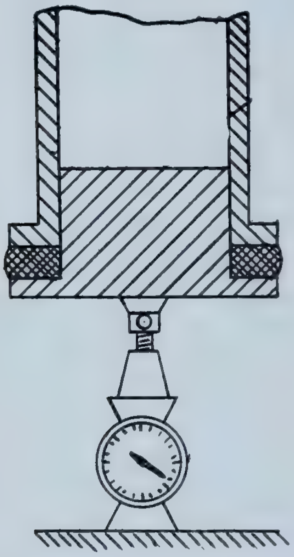
◆

TENSION ON CYLINDER COVER STUDS.

By R. Bell.

I READ with interest the article, entitled "Tension on Cylinder Cover Studs," by J. H. Rodgers, in the January issue of The Power House. From such articles there is certainly a great deal of benefit to be derived, and especially by us in the outlying districts of this western land, where we are out of reach of technical schools and other such excellent institutions.

While the answer may seem very clear to each of us, whatever may be our opinion, still there is always the other side to consider, and, in doing so, we may have to hunt out some of our old text-books, which may have the dust of years on them, though they ought not to have; and, although we may not get any new light on the point at issue, still we are the gainers by having considered two sides of some problem, which, perhaps, never before crossed our minds. Could we but have some such question brought before us each week and debate it out in our own minds or with our fellows, many a man would get out of the rut and become a thinker instead of a mere machine.



With regard to the question raised, I am of the same opinion as Mr. Rodgers. The pressure on the studs does increase, and the figures shown in the article demonstrates to my mind quite clearly the conclusions arrived at. I reason it out in this manner. The sketch shows a cylinder and cover which, for the sake of demonstration, is made so that the cover is free to move through a certain distance. The spigot of the cover goes well into the cylinder, and is steam-tight where it fits into the cylinder. There is further a compressable joint between the cylinder and cover. The area of the cylinder is 100 square inches. Suppose the cover, instead of being held in place by studs, to be blocked up by means of a strong steel balance and have pressure applied by a screw jack interposed between the balance and cover until the balance shows 10,000 lbs., being the pressure mentioned in the original question raised by Mr. Jones; in other words, ten studs screwed up to a tension of 1,000 lbs. each.

Now, I hold that for every 1 lb. per square inch of steam pressure admitted to the cylinder the balance will show another 100 lbs. The pressure mentioned in the question is 80 lbs. per square inch, and this on an area of 100 square inches would be 100×80=8,000 lbs. Our balance at this pressure would, therefore, register 10,000+8,000=18,000. The balance is taking the place of studs in this experiment, and if the balance indicates this extra pressure, why should the studs likewise not receive it?

With regard to the question raised by Mr. Orr: "Does the pressure of steam against the inside of a cylinder cover lessen the screwing-up presure with which the studs hold the cover against the cylinder end?" I should say it certainly does, and that pressure reaches zero when the pressure exerted on the inside of the cover is equal to the total tension on the studs holding the cover in place. The tensile strength of the studs, of course, continue to hold the cover in place after that point is reached.

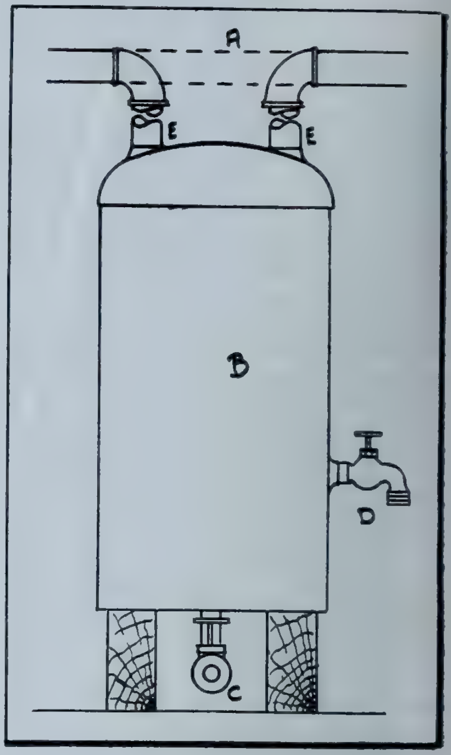
◆

GETTING RID OF THE SAND.

By J. E. N.

AT the present time, Toronto engineers are having loads of trouble in the shape of loads of sand, being carried in the cold water supply to their hot well and other pump features and fixtures. Brass plungers, valve seats and packing are being destroyed by the sand which the Water Commissioners are supplying at the price of water. Now this state of affairs may be pie to the builder who has to simply open up a valve and allow the sand and water mix-to flow gently over the lime, although there may be more sand than water. With the poor engineer it is a different story, for he has to stay late at night, and maybe work Sundays to repair the damage caused by sand during the week's run.

Here is the scheme I am using with success to get rid of the sand before it reaches the pumps, etc. Originally, the one inch iron pipe feed had a straight run, as shown at (A) by dotted lines, I secured a 100 gallon range boiler (B), cut out the piece of pipe at (A), and connected the boiler as shown. The water enters at (E) and leaves at (F), while the sand falls to the bottom and is blown out at intervals by the valve (C). The hose for washing out, etc., can be connected to the cock D.



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The Kent Co., Ltd., Montreal, representing the Armstrong Cork Co., Pittsburgh, have recently put on the market what is known as a "Nonpareil Insulating Brick." The brick is 9 x 4 x 2½ inches, of light terra-cotta color, and weighs about 1½ pounds, or 29 pounds per cubic foot. The heat conductivity is state dto be approximately 12 b.t.u. per square foot per degree Fahr. difference in temperature per inch thickness per 24 hours, making the insulating value about ten times greater than ordinary red brick. The brick is composed of infusorial earth, a small amount of clay, and finely-ground cork, and has a fusing of 1,600 degrees Fahr. It is designed for insulating hot surfaces, such as boiler settings, breechings, furnaces, etc., but not being refractory, has to be protected by fire brick against excessively high temperatures. It is usually built in between two walls of regular brick or placed on the outside.

Arithmetic for the Machinist and Operative Engineer

By J. H. Rogers

Doubtless some of the elementary work in the first few articles of this series may appear more or less superfluous, but it must be remembered that numerous simple rules and formulae appear from time to time in Technical Journals, which are discarded and dubbed impractical by many operators for the simple reason that the elementals are either unknown or have been forgotten. The purpose of this course will have been achieved if the above tendency is even in part combatted.

INTRODUCTORY.

IT seems to be the unversal opinion among a great number of present-day mechanics and apprentices, that the use of figures or a general knowledge of advanced arithmetic should belong to the man higher up, the foreman, superintendent, or draughtsman.

While, to some extent, the present methods of modern manufacture, especially in large establishments, tends to eliminate from the average workman one of his greatest assets, that is, the mental faculty, which enables him to see and do things before they are actually performed, there should be no good reason why the workman, to some extent, does not become conversant with the theoretical portion of his daily labors. Some men may argue that the use of mathematics in the shop is of little importance to the average man or boy employed at the bench, on the machine, or in the power plant.

This reasoning may hold good if the man or boy has become content to remain at his present level for all time to come; but, to the ambitious person who is desirous of climbing farther up the ladder, it behoves him to fit himself to the duties of the rung above that on which he is standing. How often do we hear the remark? "He's a lucky guy," when the more reasonable view to take would be that of asking the question, "Is he a lucky guy?"

While luck or pull may have something to do with the advancement of a few, it is generally the ability of the person that secures for him the position, and his fitness that keeps him there. Few, if any, of us, would proceed very far if we were to wait and let someone push us into one of these "lucky" jobs. Although it is true, that the wheels of industry to-day are kept in motion largely by the strength and energy of men of muscle, it remains an unquestionable fact that these same wheels were first put in motion by men of brains.

Where would the steam engine of to-day be had it not been for the active mind and reasoning faculty of Watt and Stephenson?

What would the world be deprived of to-day, but for the discoveries by scientifically applied thought of such men as Franklin, Volta, Faraday, Ohm, and Ampere, and the ever-planning of Edison and Marconi?

When the identity of lightning and electricity was discovered by Benjamin Franklin, people asked, "Of what use is it?" The retort of the great philosopher was, "What is the use of a child? It may become a man." Many great revolutionary projects of to-day had apparently very insignificant beginnings, and the same may prove true of many men and boys whose only ambition seems to be to fill in the few hours that they spend in the factory.

Problems of the Daily Task.

Granting that the use of higher mathematics may be the special duty of more learned men than those usually found in the workshop, there are still many problems that the mechanic meets in his daily labors that could be more intelligently handled than at present if a general knowledge of the art of figuring was better understood by those called upon to face these questions.

Many of these shop problems, if given to the average boy just after leaving school, could be correctly solved, but the fact that the young men of to-day usually spend a year or more after leaving school before they settle their minds to the adoption of a trade leaves time enough for their brains to become rusty. Even polished steel will become oxidized if care is not taken to retain the surface of the metal.

Of what use is the knowledge we received while at school if in after life we do not take advantage of it when the occasion demands? Many workmen who are capable of solving a written question in certain lies of mathematics seem unable to grapple the same problem when met in a practical way in the shop. The study and application of calculation to practical problems in the shop exerts an influence in broadening the mind, and often keeps a person from becoming an automation or human machine.

This course of lessons in practical shop arithmetic while intended for those not conversant with the application of the principles of mathematics as applied to shop problems may also prove of some interest and help to those who to some extent are accustomed to using calculations in their daily efforts. In outlining the lessons, it will be assumed that the readers are familiar with the four elementary principles of arithmetic, namely: addition, subtraction, multiplication, and division as taught in the public schools. As far as possible the problems and solutions will deal directly with practical work, so as to appeal to the average man or boy working in machine shops, power plants, and engineering works, generally.

Throughout the course, many formulae will be necessary, but those who are not familiar with this branch of mathematics should have no scruples about using them, as they are only a short method of expressing a rule, and a little study on the part of the average man or boy will make them sufficiently proficient to understand those met with in this series of shop lessons.

Arithmetical Axioms.

Arithmetic is the art of reckoning or study of numbers.

Addition is the process of finding the sum of two or more numbers. The sign of addition is + (plus). The sign of equality is = (equals); thus, $9+2=11$ would read nine plus two equal eleven.

Subtraction is the process of finding the difference between two numbers. The sign of subtraction is − (minus); thus $40-15=25$, and reads forty minus fifteen equals twenty-five.

Multiplication is the process of multiplying one number by another, or adding one number to itself a certain number of times. The sign of multiplication is × (times or multiplied by); thus, $25\times5=125$ reads twenty-five times five equals one hundred and twenty-five. Again by addition, $25+25+25+25+25=125$.

Division is the process of finding how many times one number is contained in another. The sign of division is ÷ (divided by); thus, $42\div7=6$ reads forty-two divided by seven equals six.

Chart (1) illustrates the position and names of the various terms used.

Cancelation.

Many calculations in multiplication and division can be considerably shortened by cancelation, or the casting out of equal factors from both dividends and divisor.

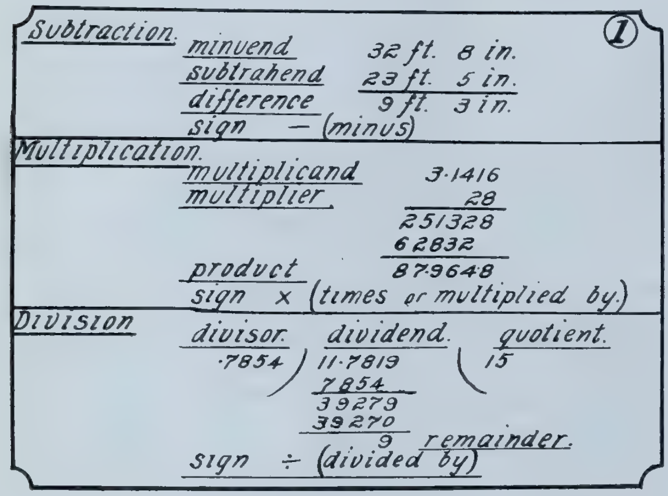
The **factors** of a number are those numbers which, when multiplied together will equal that number; thus 12 and 6 are factors of 72 since 12×6 =72.

Canceling equal factors from both divisor and dividend does not alter the quotient. Thus, dividing each term of the fraction 48/64 by 4 we get 12/16; again dividing each term by 4 we have ¾. When canceling, be sure and remove an equal factor from both terms of the fraction. Example:—

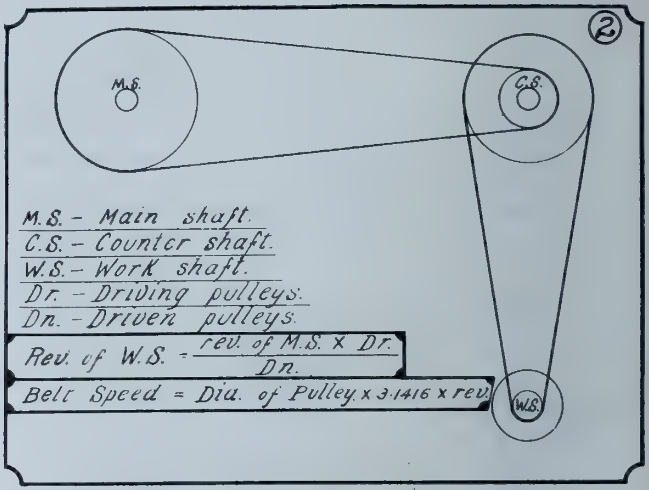
Divide 18×15×24 by 5×36.

$$\frac{\overset{1\quad 3\quad 12}{18\times15\times24}}{\underset{\substack{1\quad 2\\ \quad\;\; 1}}{5\times36}}=\frac{}{1\times1}=\frac{}{1}=36$$

Explanation:—The 5 in the divisor and the 15 in the dividend are both divisable by 5, as 5÷5=1 and 15÷5=3. Again 18÷18 = 1, and 36÷18 = 2. Further, 2÷2 = 1 and 24÷2 = 12. The cancelation being complete leaves the relation of the dividend to the divisor the same as before, but much simplified. Multiplying the remaining factors in both terms, we have 1×3×12=36 and 1×1=1; then 36÷1=36.



ARITHMETIC CHART 1.



ARITHMETIC CHART 2.

To avoid confusion, always cross out or cancel the factor affected by the process of the division. It is usual to omit the 1 when a factor is being divided by itself, as:

$$\frac{3}{6}=\frac{3}{\underset{2}{6}}=\frac{1}{2}$$

Example, see Chart 2.—An emery wheel is required to have a speed of 2,200 r.p.m. The main shaft has a speed of 185 r.p.m., and diameter of pulley on work shaft, W.S.=4 inches. Assuming we have pulleys for counter-shaft of 24 inches and 15 inches diameter, find the main-shaft.

In problems of this nature the speed of the driving shaft multiplied by the diameters of all the driving pulleys will equal the speed of the driven shaft multiplied by the diameters of all the driven pulleys, or expressed in the formula, Chart 2.

Revs. of M.S. × Dr. = revs. of W.S. ×Dn., or

$$\text{Revs. of W.S.}=\frac{\text{Revs. of M.S.}\times\text{Dr.}}{\text{Dn.}}\text{, then}$$

diameter of driving pulley on main-shaft

$$=\frac{\overset{1100\quad 3}{2200\times15\times4}}{\underset{\substack{37\quad 6\\ \quad\;\; 2}}{185\times20}}=\frac{1100}{37}=29\frac{27}{37}\text{ ins or}$$

say, a 30 in. pulley.

Fractions.

A common fraction is a certain part of a whole number.

The terms of a fraction are the numerator and the denominator.

The value of a fraction is the numerator divided by the denominator.

A fraction may be changed to higher terms of the same value by multiplying both terms by the same number; as ⅜ to twenty-four sixty-fourths. Multiplying each term by 8 we get 3×8=24, and 8×8=64, therefore ⅜=24/64.

Also, to change to lower terms having the same value, divide, if possible, each term by the same number.

To reduce a fraction to an equal fraction having a given denominator. Divide the given denominator by the denominator of the given fraction, and multiply both terms by the result. Thus ⅞ to thousandths. Then 1000÷8=125, and multiplying both terms by 125, we have 875/1000.

In addition and substraction of fractions, the fractions must be changed so they will have a common denominator. Thus, it would not be convenient to add ⅜, ¾, 7/16, 33/64 and 35/100. We must change them to fractions of the same value but with a common denominator. To accomplish this, we place the denominator in a row, thus

$$\begin{array}{ccccr|ll} 8 & \quad 4 & \quad 16 & \quad & 2 & 64 & \quad 100\\ \cline{6-7} & & & & 2 & 32 & \quad 50\\ \cline{6-7} & & & & & 16 & \quad 25 \end{array}$$

If any of these numbers are contained equally in one or more of the others, it may be eliminated. thus, four goes into 8, therefore, cancel 4. Eight goes into 16, therefore, cancel 8; sixteen goes into 64, therefore cancel 16. This leaves 64 and 100. Now, 64 will not go into 100; but we see that there are still factors of both numbers that are common to each other. To eliminate these, we proceed as follows:—Divide both numbers by a prime number; in this case 2. We get 32 and 50: Again, dividing by 2 we get 16 and 25. Now, these numbers, 2, 2, 16 and 25 when multiplied together will give what is known as the Least Common Denominator.

Addition of Fractions.

When changing to fractions having the least common denominator, write the sum of all the numerators over the common denominator, and, if necessary, change to a mixed number.

Subtraction of fractions.

When changing fractions to other fractions having a common denominator, subtract the numerators as is done in whole numbers and place the difference over the common denominator.

Multiplication of Fractions.

In multiplication of fractions, it is not necessary to use a common denominator. Divide the product of the numerator by the product of the denominators. All factors common to both terms should first be cast out by cancelation. When mixed numbers are involved, first change them to improper fractions; and if the answer is an improper fraction, change to a mixed number.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent practical questions, and give same direct, reliable answers. Catch questions will be avoided. Attention is drawn to the accompanying course in arithmetic, a concurrent study of which is recommended with that of the Question and Answer Series.

Question.—Give a definition of the mechanism as expressed by the word **Turbine.**

Answer.—A turbine is a prime mover in which gradual changes in the momentum of a fluid are utilized to produce rotation of the moving members.

* * *

Question.—Explain the difference between a turbine as above described and a rotary engine.

Answer.—In order to fulfil the requirements embodied in the answer to the first question, the only method suitable in practice for communicating the fluid energy to the rotor parts is to occasion a change in the fluid velocity. It should, therefore, be noted that pressure plays no part in the operation. A rotary engine on the other hand depends for its action on pressure, and in consequence is a mechanism entirely distinct from the turbine.

* * *

Question.—What is understood by the **Load Factor** in an electrical installation?

Answer.—The load factor of an electrical power plant or any unit of it is the ratio of the average output to the maximum. Thus, if, in an electrical installation, M=the maximum kilowatt output, and K=the total output in N hours, then the load factor for that period is $\frac{K}{M \times N}$. As this is commonly expressed as a percentage, the load factor $=\frac{K \times 100}{M \times N}$. The period usually taken is one year, therefore the load factor=

$$\frac{\text{Total Units Generated} \times 100}{\text{Maximum Load} \times 24 \times 365}$$

* * *

Question.—What do we understand by the expression, **Total Heat of Steam?**

Answer.—By the total heat of saturated or boiler steam is meant the number of heat units required to produce one pound of steam from a temperature of 32 degrees Fah. to any given temperature and pressure. The total heat includes the latent heat of steam formation and the sensible or thermometer heat.

* * *

Question.—What is understood by the term **Horse Power** as applied to steam boilers?

Answer.—Horse power when used with reference to steam boilers means the capacity to evaporate 30 pounds of water per hour from a temperature of 100 degrees Fah. into steam at 70 pounds gauge pressure, or 34½ pounds of water evaporated per hour from a feed water temperature of 212 degrees Fah. with steam at atmospheric pressure. This unit of power is that adopted by the American Society of Mechanical Engineers and generally accepted on this continent as a standard.

* * *

Question—What steps should be taken previous to putting a new boiler into operation, so as to ensure that the internal surfaces are thoroughly clean?

Answer—Before putting a new boiler into operation, it should first be well boiled-out for at least 24 hours with a strong solution of compound, using the surface and bottom blow-off for about two minutes each hour; feeding with distilled water, if possible, to make up the loss, and adding more compound after each blowing-off. Again, before starting the use of compound in an old boiler, the same preliminary details should have attention; the reasons for their adoption being as follows:—

(1)—When starting-up a new battery of boilers, there is always found more or less greasy scale and dirt thrown down, even when good distilled water is used for boiler feed.

(2)—In an old boiler which is considered to be as clean as possible, a good compound will cut a very considerable amount of grease and scale from the apparently clean surfaces.

(3)—In an old boiler which has not been cleaned, the action of the compound would first be to form colloidal solutions with any scale-forming ingredients that are in the water. The excess of compound then acts on the scale and grease attached to the various surfaces, loosening and throwing them down on to lower surfaces, and in time dissolving these impurities. If the boiler be boiled out, using good water with the compound, much of this scale and grease will be loosened and a great part of it can be removed through the blow-off. After boiling and blowing for 24 hours, the fires should be allowed to die out, and before the pressure is entirely gone, all the water should be blown out. The lower manhole and handhole plates should then be taken off and all loose scale raked out. If this is not done the loose scale and greasy solution may do the boiler harm.

Question—What is the generally accepted meaning of the expression, **Isolated Plant**, as applied to a power station?

Answer—An isolated plant is one which produces power by means of prime movers, the method of application being immaterial. The plant is isolated from the central station, and, in the broad sense of the word, a small central station in territory supplied by a large central station would be classed as an isolated plant.

* * *

Question—What are the usual arrangements of Corliss valve gears in steam engine practice?

Answer—Gears without trip motion, the valves having a positive connection with the eccentric, the travel constant, and the point of cut-off invariable. This arrangement is not, however, much used.

Single eccentric gears with trip motion in which the steam valves are not positively connected to the eccentric, but are opened by trips or catches against the resistance of a dash-pot, and released at some point of the engine stroke, determined by the governor or otherwise. The exhaust valves are positively connected to the eccentric and receive therefore a constant movement.

Double eccentric gears with trip motion in which the steam valves are connected and operated in the same manner as those of the single eccentric with trip gear. The exhaust valves are, however, driven from a separate eccentric.

* * *

Question—What is Boyle's Law?

Answer—Boyle's Law defines a perfect gas as having a constant pressure volume.

$$pv=\text{constant}.$$

Example—Steam at 100 pounds pressure in a vessel of 10 cubic feet capacity.

$$100 \times 10=1000.$$

If we pass that steam into another vessel which is 20 cubic feet capacity, the pressure will fall to 50 pounds, thus:

$$\frac{1,000}{20}=50 \text{ pounds},$$

showing that the constant value remains the same. It is this volume increase, that calls for ports and exhaust pipes being larger in area than live steam admission openings and live steam pipes; the pressure being lower.

ASSOCIATION AND PERSONAL

A Monthly Record of Current Association News and of Individuals Who Have Been More or Less Prominent in the Power Field.

Colonel Ruttan, Winnipeg city engineer, addressed the University of Manitoba Engineering Society, two weeks ago.

A. J. MacLean, a former commissioner, assumed the duties of Assistant City Engineer of Edmonton, Alta., on February 2.

D. W. Johnson, for the past five years municipal engineer of Point Grey, B.C., has resigned, having accepted a similar appointment at Saanich, B.C.

J. W. W. Drysdale, Jr., B.Sc., director of Drysdale and Co., Glasgow, Scotland, manufacturers of centrifugal pumps is in Canada on a brief business trip.

M. J. Butler was elected president of the Canadian Society of Civil Engineers at their twenty-eighth annual meeting held in Montreal recently.

Professor Herdt, of McGill University, and R. S. Kelsch, consulting engineer, Montreal, are inquiring into the cost of power as furnished the City of Fort William by the Kaministiqua Power Co.

A. D. Stephens, chief engineer of Dominion No. 1 Colliery, Cape Breton, who has been on the sick list the past three weeks is now rapidly recovering, and will be about his accustomed duties in a week or two.

F. Ross Newman, resident manager in Toronto of the Canadian Fairbanks-Morse Co., sailed from New York on Saturday for Europe, where he will spend a short holiday. During his absence George E. Fisher is in charge.

Engineers' Club, Toronto.—At the annual meeting of the Board of Directors of the Toronto Engineers' Club, the following were elected officers for the coming year:—President, Col. A. Van Nostrand; 1st Vice-President, Charles H. Hays; 2nd Vice-President, Wm. A. Bucke; 3rd Vice-President, Edward L. Cousins.

T. J. Brown, general superintendent of the Nova Scotia Steel & Coal Co., and Vincent McFadden, chief electrician of the Dominion Coal Co., Glace Bay, N.S., are members of a commission appointed by the Nova Scotia Government to inquire into the advantages or otherwise of electricity for light, heat and power in coal mines. The commission visited Sydney recently.

BRITISH COLUMBIA ASSOCIATION OF STATIONARY ENGINEERS.

Grand Trustees: John Woodriff, Box 966, Vancouver, B.C.; J. Byers, c|o Nanaimo Electric Light Co., Nanaimo, B.C.; Geo. H. Anderson, 435 Broadway West, Vancouver, B.C.

LOCAL SECRETARIES, BRITISH COLUMBIA ASSOCIATION OF STATIONARY ENGINEERS.

Vancouver Lodge, Thos. Middleton, financial secretary and business agent, Box 966, Vancouver.

J. Axon, recording secretary, Box 966, Vancouver.

Victoria Lodge, A. M. Aitken, 268 Ontario St., Victoria, B.C.

New Westminster Lodge, T. A. Barnard, 1118 Hamilton St., New Westminster, B.C.

Cumberland Lodge, Jas. Whyte, Jr., Cumberland, B.C.

Merritt Lodge, E. Darney, Merritt, B.C.

Fernie Lodge, Percy Bean, Box 444, Fernie, B.C.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

Past President—J. A. Robertson, Stratford, Ont.

President—S. Cosford, London, Ont.

Vice-President—A. W. Heath, Hamilton.

Secretary—A. Kastella, Ottawa, Ont.

Treasurer—W. E. Archer, Hamilton.

Doorkeeper..E. Hooey, Owen Sound, Ont.

Conductor—Robert Dyson, Guelph, Ont.

Economy Pumping Machinery, is the title of a new catalogue which has been issued by Thomas & Smith, Chicago. The catalogue deals fully with the "Economy" line of pumps which includes centrifugal, bilge and deep well pumps, sewage ejectors, etc., motor or belt driven. Each type is illustrated and described together with a table giving principal sizes and ratings. In many cases a specification is included. The catalogue also contains some suggestive specifications and several pages of useful information on pumps and hydraulics, which will be helpful when considering pumping propositions.

Canada Metal Co., Convention.—The Annual Convention of the managers and sales staff of the Canada Metal Co. was held at the head office, Toronto, recently, when managers were present from the Montreal and Winnipeg offices, and salesmen were gathered from all parts of the Dominion. At the opening function, W. G. Harris, Jr., vice-president, stated what a pleasure it was once more to meet their representatives in Toronto. In a concise manner he dealt with the objects of the Convention. Amongst these was the exchange of ideas on trade conditions throughout the Dominion, which would prove rich in information, also the great benefit derived by general discussion. The president, W. G. Harris, Sr., also had a word of welcome and spoke of the strenuous year just past. He stated that it was a year of which every one in connection with the Canada Metal Co. had just reason to be proud, for it was the best and most progressive year in the history of the company. Many interesting papers were read by the various salesmen upon a diversity of subjects.

LODGE SECRETARIES, CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

F. Chesher, 152 Charles St., Belleville, Ont.
A. W. Heath, 111 Burris St., Hamilton, Ont.
W. G. Walters, 211½ Dundas St., London, Ont.
J. W. Marr, 78 Duke St., Toronto, Ont.
F. Revell, P.O. Box 84, St. Thomas, Ont.
S. Smith, 506 VanNorman St., Port Arthur, Ont.
W. Needham, 2089 3rd Ave. East, Owen Sound, Ont.
J. Thompson, P.O. Box 109, Stellarton, N.S.
W. Congdon, 23 Dower St., Chatham, Ont.
R. Dyson, 211 York Road, Guelph, Ont.
J. A. Robertson, 68 Nile St., Stratford, Ont.
C. J. Lake, 13 Larch St., Ottawa, Ont.
J. Ogle, 73 Richmond St., Brantford, Ont.
E. W. Berry, 123 Main St., St. John, N B
F. J. Aldred, P.O. Box 191, New Aberdeen, Glace Bay.
C. Emmerich, 186 Victoria St., Berlin, Ont.
G. E. Pearce, Fire Department, Wallaceburg, Ont.
C. Caswell, Lowell Street, Galt, Ont.
W. A. Milne, 393 Princess Street, Kingston, Ont.
Chas. Maidel, 64 Pitt Street E., Windsor, Ont.
J. J. McCaffrey, P.O. Box 35, Trout Mills, North Bay, Ont.
T. J. Mackle, Brampton, Ont.
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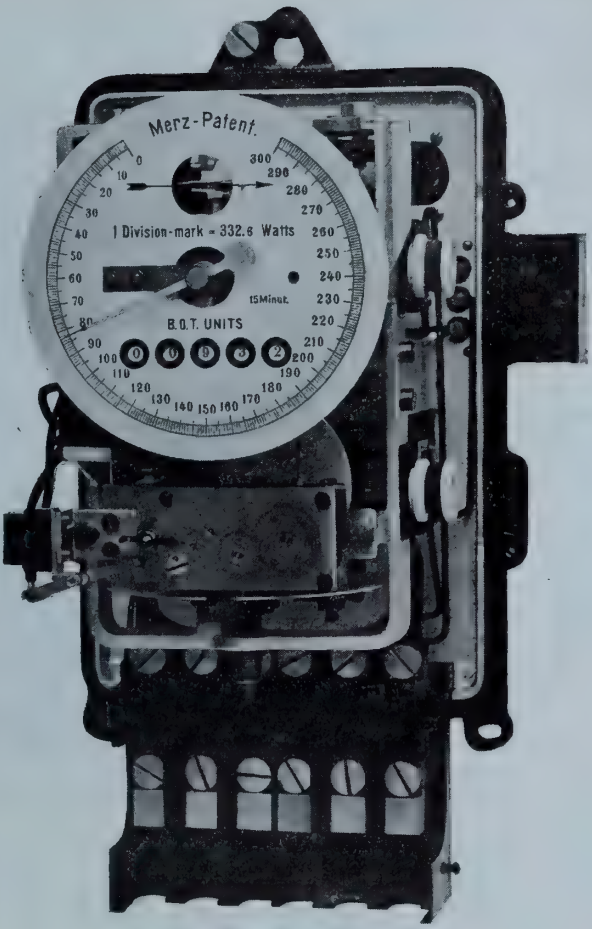
1. Gives the kilowatt hours.
2. The highest load demanded in watts on a time average of say 15, 30 or 60 minutes.

The accurate measurement of these two quantities enables a true load factor system of charging to be adopted.



What can be done with the Meter

1. Charge an annual sum per K.W. year or Horse power year to cover capital and standing costs.
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SIEMENS LOAD FACTOR METER
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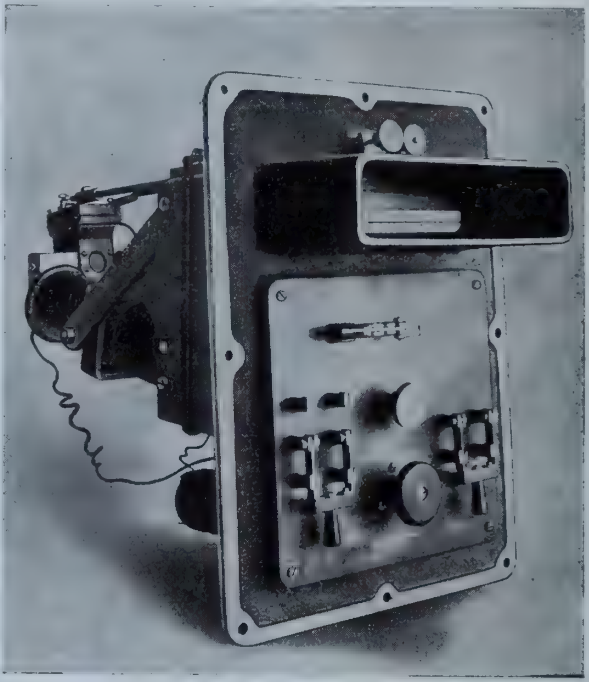
PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

NEW TYPE VOLTMETER.

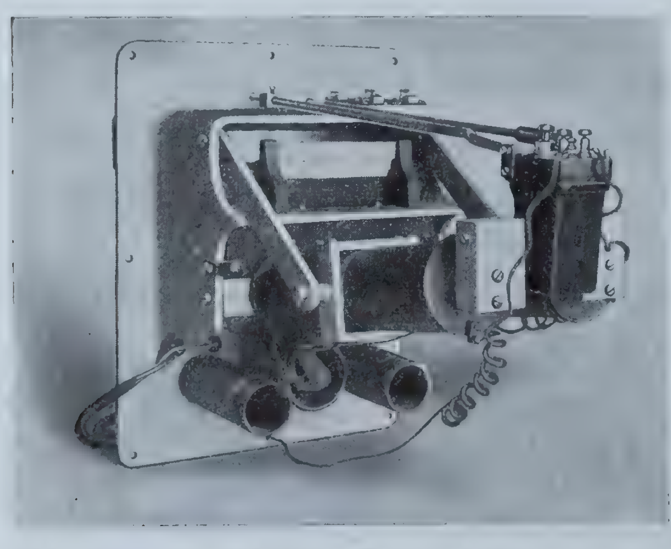
IN the testing of insulated wires and cables designed for a great variety of purposes, a voltmeter as we have known it heretofore, often fails to measure adequately the stresses to which the dielectric is subjected. Based on the integration of the sine wave—on the square root of the mean square of instantaneous values — voltmeter readings give little or no indication of unusual peaks in the voltage wave or of surges in the circuit.

The need of an instrument which would give such readings arose in connection with the high voltage testing of wires and cables, it being well-known that, in such tests, the peak of the wave is what counts in breaking down the insulation. So long as a sine wave is maintained, the ordinary voltmeter indicates the peak voltage—a definite percentage above the voltmeter reading, but in cable testing, there is a considerable charging current, due to the electro-static capacity of the cable. As this current is likely to distort the wave form, the ordinary voltmeter may give no definite information as to peak voltage.

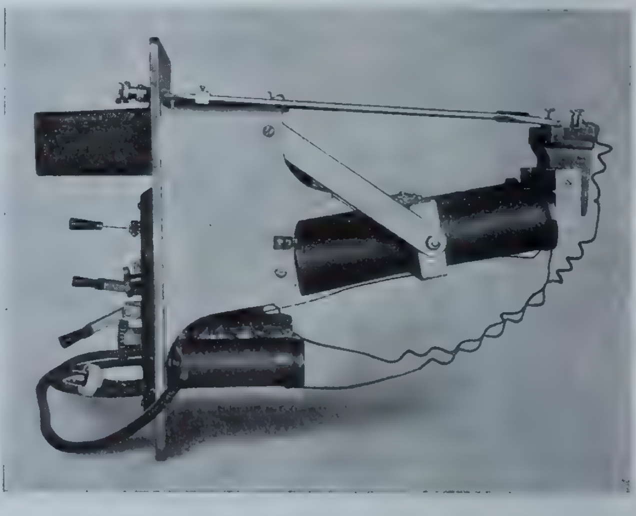


FRONT VIEW—SIMPLEX PEAK VOLTAGE METER SHOWING CONTROL BOARD AND SCALE.

After trying and discarding both a spark gap, which proved to be too easily affected by outside conditions, and an oscillograph, which is too delicate an instrument for factory use, the engineers of the Simplex Wire & Cable Co., Boston, proceeded to develop for their own use apparatus which would give the required results. Based upon the principle of the oscillograph, but with its movement confined to a straight line, the new instrument, illustrated herewith, indicates the peak of the voltage wave at the limit of oscillation along that line. It does not show the character of the wave or the form of its peak, but it



REAR VIEW—SIMPLEX PEAK VOLTAGE METER, SHOWING DETAILS OF CONSTRUCTION.



GENERAL CONSTRUCTION OF NEW METER.

Does what
we claim

WARRANTY

We guarantee **PEROLIN** the German Boiler Metal Treatment.

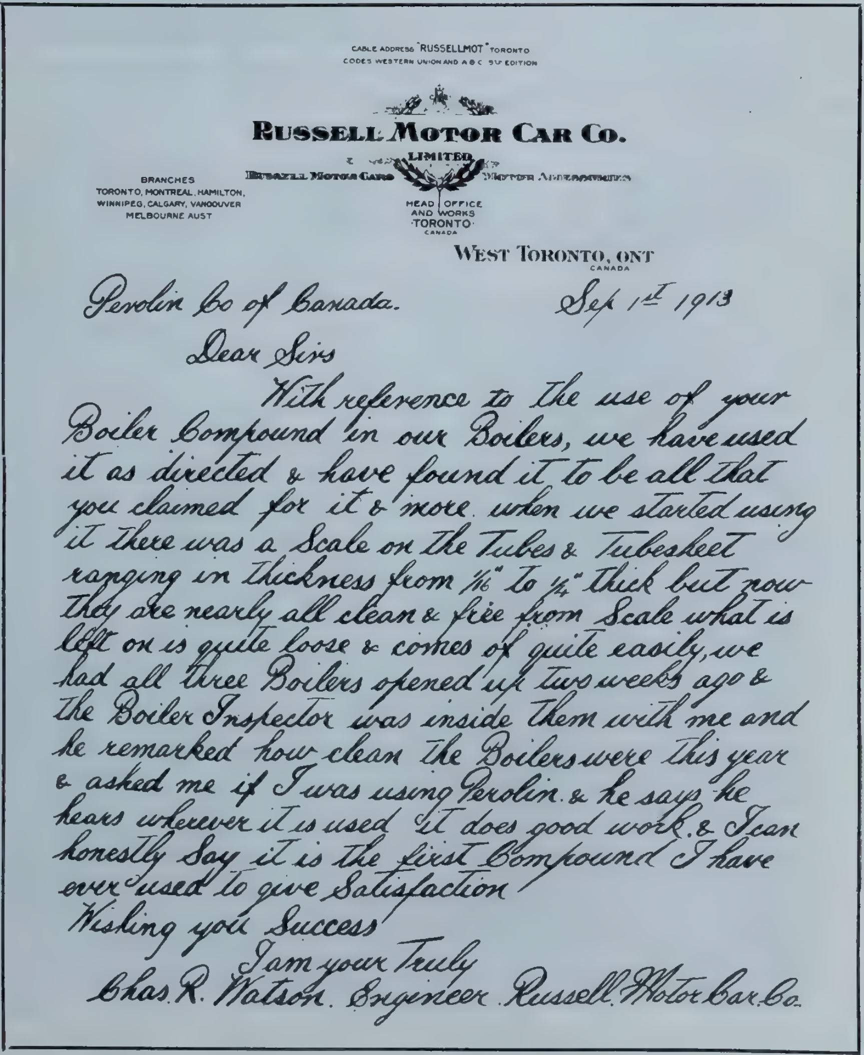
1. To remove scale already formed in your boilers.
2. To prevent new scale from forming.
3. To stop all pitting, corroding and galvanic action.
4. Not to corrode or injure the boiler metal or packing.
5. Not to affect or impart any off-odor to steam generated from the water.
6. To correct oil troubles caused by oil or grease getting into boiler water.
7. Not to affect the product of Breweries, Ice Plants, Creameries, Dye Works, or any Product where live steam is used in the manufacture of their goods.
8. That it does not affect the water, neither is it affected by the water, and that the Perolin Preservative Film is a good transmitter of heat.

PEROLIN does not treat the water.

PEROLIN **preserves** the Boiler Metal, and we guarantee the Perolin Preservative Film to be a good transmitter of heat.

PEROLIN will prove just as agreeably effective in your boilers as in others'. We stand ready to demonstrate it at **our** expense — **no cure, no pay.**

Will you write us to-day for further particulars?



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WEST TORONTO, ONT
CANADA

Perolin Co of Canada. Sep 1st 1913

Dear Sirs

With reference to the use of your Boiler Compound in our Boilers, we have used it as directed & have found it to be all that you claimed for it & more. when we started using it there was a Scale on the Tubes & Tubesheet ranging in thickness from 1/16" to 1/4" thick but now they are nearly all clean & free from Scale what is left on is quite loose & comes of quite easily, we had all three Boilers opened up two weeks ago & the Boiler Inspector was inside them with me and he remarked how clean the Boilers were this year & asked me if I was using Perolin & he says he hears wherever it is used it does good work. & I can honestly Say it is the first Compound I have ever used to give Satisfaction

Wishing you Success

Iam your Truly
Chas. R. Watson. Engineer Russell Motor Car Co.

Perolin Company
of Canada, Limited
Standard Bank Bldg., Toronto, Ont.

does give very clearly the reading for that peak, whatever the shape of the wave may be. This peak voltage meter, in its original crude state was used successfully in the Simplex factory for some time, and thus thoroughly tested out. It has just been completed in its present form, after an experimental period extending over two years.

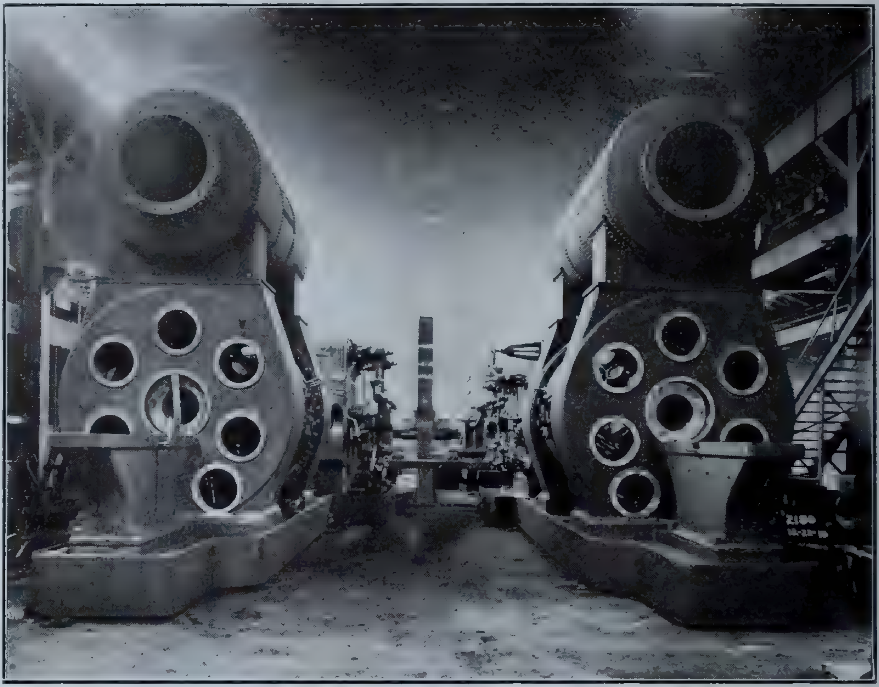
The voltmeter, which is of switchboard type, measures about 10 by 12 in. on the front and 14 in. deep. It consists essentially of a heavy electromagnet, between the poles of which is located the vibrator. By a suitable arrangement of lamp, mirror and lenses, a beam of light is thrown on a ground glass scale in front, graduated in volts. This instrument is connected, through a potential transformer, directly on the high voltage circuit, the current being so small that the apparatus can be left in the circuit all the time. It can be quickly calibrated at any time by applying direct current of known voltage.

This interesting example of the development of an invention to meet a particular factory need might prove of considerable value in other lines as well as that of the manufacture of insulated wires and cables, but its principal indication is the readiness of the American manufacturer to undertake both the deep study and the careful experimental work needed to provide him with the tools with which his regular work can be carried on to best advantage.

◆

RECORD IN BUILDING LARGE ENGINES.

WHAT is believed to be the world's record in constructing engines was recently accomplished by the Mesta Machine Co., of Pittsburg, Pa., in building two horizontal cross compound blowing engines for the Woodward Iron Co., Woodward, Ala. The first engine was completed and loaded on board cars at the Mesta Works in 38 days, and the second one in 59 days from the date of signing the contract at Woodward, Alta. Each of these engines embraces one high pressure steam cylinder, 48 inches in diameter, one low pressure steam cylinder 84 inches in diameter, and two air cylinders 84 inches in diameter, with a stroke of 60 inches.

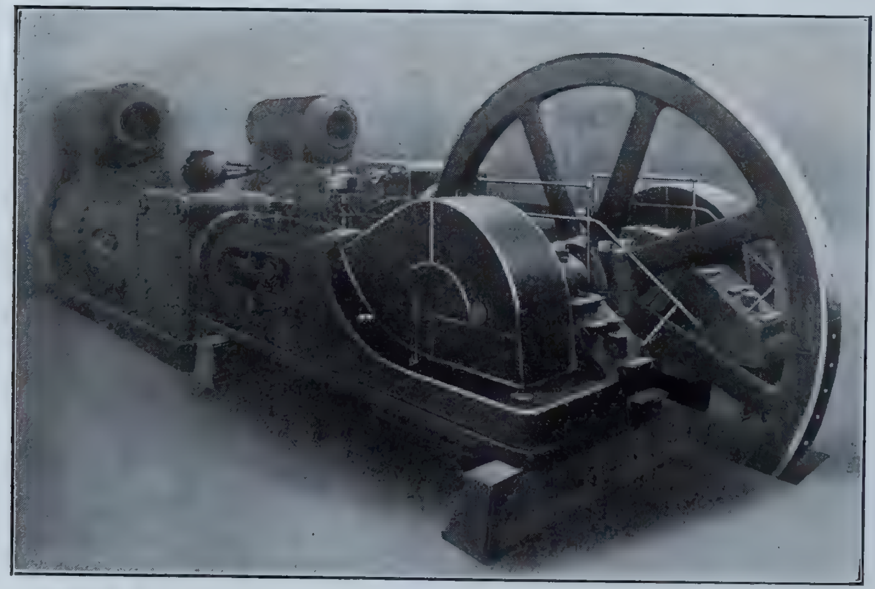


AIR RECEIVERS AND AIR CYLINDER ENDS 48-84-84 IN. X 60 IN. CROSS COMPOUND BLOWING ENGINE.

The Woodward Iron Co. had installed two large turbo blowers to furnish blast for their new 500-ton furnace, recently completed. These blowers were in operation for about a week, only, when both were wrecked. It was then decided to replace them by reciprocating steam engines. After investigating different types, they decided on horizontal cross compound steam engines. Quick delivery was of course all important.

The Mesta Machine Co. offered their new type of horizontal cross compound blowing engine, equipped with the Iversen patent automatic plate valves, and agreed to deliver the first engine on board cars at the Mesta Works in 90 days and the second engine in 120 days. On November 15, 1913, a contract was signed for two of these engines, with delivery as stated above, a bonus and penalty clause being included.

The magnitude of the task is better realized by a statement showing the work handled. The engines weigh 1,800.000 lbs., and contain 10,210 pieces. The lightest piece weighs one-fourth of an ounce, the heaviest piece 94,550 lbs.



48-84-84 IN. X 60 IN. CROSS COMPOUND BLOWING ENGINE ON ERECTING FLOOR.

Description of the Engines.

The engines are of the horizontal cross compound type, with the air cylinders placed directly back of the steam cylinders. Both the high and low pressure steam cylinders are equipped with Corliss valve gear and the air end with Mesta (Iversen Patent) automatic inlet and outlet valves. These valves require no valve gear, and allow the air cylinders to be placed directly back of the steam cylinders. This same arrangement is used also in the design of Mesta gas driven blowing engines. A large receiver is placed over the air cylinders, which practically eliminates vibration in the air lines to the furnace. The engines are designed for 30 lbs. air pressure and to run at a speed of 80 r.p.m.

KEEP YOUR EYE ON THE COAL PILE

If your coal bills are gradually increasing without a corresponding increase of power, there is a reason for it, and it is a safe bet that the increase is caused by scale in your boilers. And if you have scale, the logical thing for you to do is to order a LIBERTY TUBE CLEANER and stop the useless waste.

A LIBERTY CLEANER will pay for itself many times over, and there is no other investment you can make that will pay as large a dividend for the amount invested. Think it over.

We will send you a Liberty Cleaner on trial. If it fails to do your work *better* than any other make of Cleaner, you don't have to keep it.

Descriptive Catalogue on application.

Liberty Manufacturing Company

6904 Susquehanna Street PITTSBURGH, PA.

Canadian Representatives:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

"TWINS" EXCITE ADMIRATION

Because They Earn It

Think of a TWIN when you hear the word STRAINER

The installation of a Twin Strainer on your water supply line eliminates troubles, worry, waste of time and expense—because

It has two straining baskets—that may be cleaned alternately, thus permitting continuous operation.

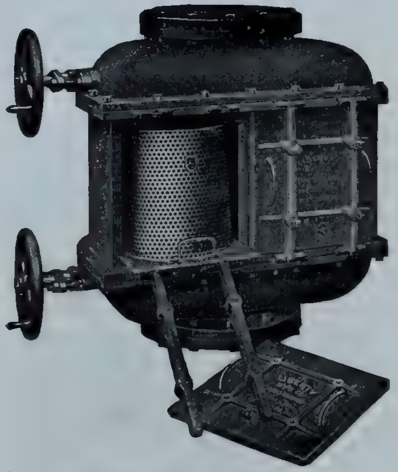
It has but two valves—they are of the gate type and are always tight.

It gives a direct flow with minimum friction loss, insuring easy operation with no waste of energy.

In fact, a Twin Strainer is an insurance policy in active service.

Designed to protect and built to last.

Write for our bulletin.



THE TWIN STRAINER.

ELLIOTT COMPANY

6902 Susquehanna Street, PITTSBURGH, PA.

Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

Electrical

Collingwood, Ont.—The Imperial Wire and Steel Co. have made a contract for 350-h.p. Hydro-Electric power, to be supplied some time this month. Another 100 h.p. will be necessary for a new addition shortly to be erected.

Maisonneuve, Que.—The shipbuilding plant of the Canadian Vickers, Ltd., will be driven by electrical motors, constructed in England by Vickers, Ltd. Current at 10,000 volts will be supplied by the Montreal Light, Heat & Power Company.

Fredericton, N.B.—F. W. Barbour, consulting engineer, Boston, has advised the council not to accept the proposition of the Eel River Light, Heat and Power Co. to furnish power to operate the pumping station. He recommended certain changes in the pumping station and filtration plant.

Longueuil, Que. — The Armstrong, Whitworth Co., of Canada, who are building a plant at Longueuil, Que., propose to install a power and lighting plant. Current will be supplied by the Montreal Light, Heat & Power Co., at 22,500 volts, which will be transformed to 2,200 volts.

Ottawa, Ont.—W. S. Edwards & Co., Sussex St., are applying to the Government to have their charter amended so that they may manufacture electricity for heat, light and power purposes. Power will be developed on the Rideau River at Rideau Twin Falls.

Nanaimo, B.C.—The Nanaimo Electric Light and Power Co. have installed a direct connected 450 h.p. unit, supplied by James Howden & Co., Glasgow. The generator was the product of the Bruce, Peebles & Co., Edinburgh. There was also installed a six-panel switchboard, a Stillwell heater, and a Worthington feed pump. Further equipment will be required for a service to South Nanaimo.

Cobalt, Ont.—Last week, acting under instructions from M. J. O'Brien, mine-owner and contractor, Sutcliffe & Neelands, civil engineers, of New Liskeard, put men at work to get information concerning the possibility of developing the water-power on the Quinze River, near the head of Lake Timiskaming. Mr. Neelands believes that the Quinze River has power enough to develop 270,000 horse-power, and thinks this would be sufficient to electrify the T. & N. O. R. and supply heat, power and light for all the industries of Timiskaming.

Kingston, Ont. — The Napanee River Improvement Co. has made a power offer to the Utilities Commission of Kingston. It owns property at Third Lake Depot, 35 miles from the latter city, where there are falls with a 65-foot drop, with at least 1,000 horse-power for the whole year, and 2,000 horse-power for eight months available. This power could be brought to Kingston at an expenditure of about $50,000.

Municipal

New Toronto, Ont.—If the ratepayers approve, $27,000 will be spent to provide a water and filtration system.

Lethbridge, Alta.—It is likely the capital estimates to be tabled by Commissioner Grace will contain an appropriation of about $15,000 for the installation of meters on all water connections in the city.

Winnipeg, Man.—City Engineer Ruttan has recommended to the fire, water, light and power committee that the steel pipe which now extends from well 10 to near well 28 be continued to a point close to Popular Springs, a distance of 25,080 feet.

Ottawa, Ont.—Judge Latchford on Feb. 7, granted an injunction against the city's proceeding further with Sir Alex Binnie's scheme to bring water from the Gatineau Lakes. The by-law had already been quashed by Mr. Justice Lennox, but the Board of Control on February 3rd opened tenders for the pipe line contract. The latest injunction declares the scheme illegal, and prevents the award of contracts, pending trial of the injunction.

Sydney, N.S.—The city is in the market for a new motor fire engine, and a fire alarm system. The storage battery system which is recommended and upon which the electrician will report in due course is with its cost as follows: 105 storage battery B. T. couples complete with electrolyte; 1-60-inch double battery rack; 1 Northern electric 4 circuit storage battery switch board; 1 one-h.p. alternating current single phase 60 cycle 110 volt motor mounted on common sub-base direct-connected to 5 ampere direct current generator.

Sudbury, Ont.—A scheme to provide the towns of Copper Cliff and Frood Mines with a pure water supply at a cost of $200,000, and provide for a population of 17,000, has been planned. The work of construction will commence without delay. The Canadian Copper Co. will finance the work. A high-pressure pumping station and a 100,000 gallon storage tank in Copper Cliff of reinforced concrete is part of the scheme.

Hamilton, Ont.—City Engineer MaCallum has submitted an exhaustive report on the city waterworks system. The secretary of the Underwriters' Association, recently recommended going back to steam power for pumping and other changes. Mr. MaCallum thinks that the city should have a duplicate pumping plant, as it now has a duplicate system of pipes. He also suggests as an alternative that the city take power from the Cataract Company and have devices for using either Hydro or Cataract power. The additional steam plant will cost $65,000.

Sydney, N.S. — Work will be commenced at once to connect Middle and Dumeresq Lakes with the city water supply. The city council will call tenders for 11,000 feet of twenty-four-inch pipe and for the clearing of a road and pipe line right-of-way to the lakes. The storage capacity of Middle Lake is estimated at 191,500,000 gallons which would it is believed, maintain a daily supply of about 6,000,000 gallons in addition to the present rate of consumption. The engineer recommends the installation of centrifugal pumps; two units of 3,000,000 capacity each, to be either operated by electric motor or oil engine. The total estimated cost is $87,000.

Classified Advertisements

Those who wish to sell or buy a business, obtain competent help, connect with satisfactory positions or secure aid in starting new enterprises, should not fail to use the Want Ad. Page of The Power House.

Do you want to sell or buy a second hand engine or any other equipment? Let The Power House pick out a seller or buyer for you.

There is always some one looking for just such proposition as you have to offer.

RATES (payable in advance):—2c. per word first insertion, 1c. per word subsequent insertion, 5c. additional each insertion when Box Number is required. Each figure counts as one work.

AGENTS WANTED

LIBERAL COMMISSIONS TO DEALERS AND others handling Vulcan Soot Cleaners; applied to all types of boilers. Vulcan Tube Cleaning Systems, Limited, 42 Craig St. West, Montreal. (tf)

SITUATION WANTED

EXPERT ERECTING AND OPERATING ENgineer, Canadian (age 28), now employed, wants change. Saskatchewan and Alberta certificates, references furnished. Chas. Fenwick, Wapella, Sask. (2)

FOR SALE

BELTING FOR SALE — 800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting & Supply Co., 5 Queen Street, Montreal. (tf)

MISCELLANEOUS

PRACTICAL COURSES BY MAIL IN STAtionary Engineering, Traction, Marine, Gasoline, Automobile, Locomotive, Electric Lighting and Power. Write, stating in what you are interested. Canadian Correspondence College, Limited, Dept. P.H., Toronto, Canada.

The Power House

Reaches operating superintending and consulting engineers in charge of steam, hydraulic and electrical power plants.

Boiler Preservative

acts on the iron—not on the water. It is a boiler treatment in a class by itself.

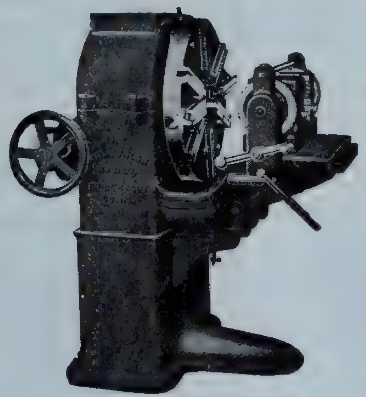
Water treatments are only partially successful, because the scale-forming sediment in water changes with seasons, climates and localities.

"MAGIC" removes scale and oil first, and then prevents scale forming. It stops pitting, corrosion and minor leaks.

"MAGIC" saves the boiler and much labor.

A trial will convince you—write us.

Canada Supply & Contracting Co., Limited
220 King St. W., Toronto, Ont.



No. 3 PIPE MACHINE
THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES
A Very Desirable Machine for
PLUMBERS and STEAM FITTERS
Manufactured by
THE ARMSTRONG MFG. CO.
298 KNOWLTON ST.
BRIDGEPORT, CONN.
Write for Catalog
NEW YORK CHICAGO

Chas. Barber & Sons
Meaford : Ontario
WATER POWER EQUIPMENT ONLY
Write for Catalogue

Protect Your Boilers With
DIXON'S
The Pioneer
BOILER GRAPHITE

Scale cannot form, no matter how bad the water, in a boiler where Dixon's Flake Boiler Graphite is used. The fine flakes coat the interior surfaces with pure graphite, to which scale will not adhere. No graphite but FLAKE graphite has this effect. Send for "Graphite For The Boiler," No. 222.

Made in Jersey City, N.J., by the
JOSEPH DIXON CRUCIBLE CO.
Established 1827.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

THE BAR-KEEPER'S FRIEND
Best known Metal Polish Guaranteed forever. Largest sale in the World.

TAKE NO CHANCES—USE MORRIS CHAIN-BLOCKS.
THE HERBERT MORRIS CRANE & HOIST COMPANY, LIMITED,
EMPRESS WORKS, Peter Street, TORONTO.
We also make Overhead Cranes and Runways.
BRANCH OFFICE, Coristine Bldg. MONTREAL.

HINTS TO BUYERS

Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

H. Mueller Mfg. Company, Ltd.
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LUBRICATING OILS

Canadian Oil Companies, Limited

TORONTO MONTREAL ST. JOHN
HALIFAX WINNIPEG
REGINA CALGARY
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For Strength, Lightness, Convenience

"AMERICAN" STEEL SPLIT PULLEYS

PATENTED.

are unequaled. Guaranteed for double belt duty under any conditions not demanding special pulleys.

Write for instructive printed matter.

The American Pulley Company, Philadelphia, Pa.

Canadian Agents:—
Williams & Wilson, Limited, Montreal, Que.
A. R. Williams Machinery Co., Limited, Toronto, Ont.; Winnipeg, Man.; St. John, N.B.; Calgary, Alberta; Vancouver, B.C.

Don't Use Boiler Compounds

Which are always injurious to boilers and valves.

We guarantee an absolute Metal Clean Boiler, when there is sufficient exhaust steam. Get the Nobis habit around your power plant.

Best References

The Nobis Engineering Co.

GUSTAV NOBIS
Rheydt, Germany
ENGINEER, MANUFACTURER AND HEATING CONTRACTOR
Founded 1880

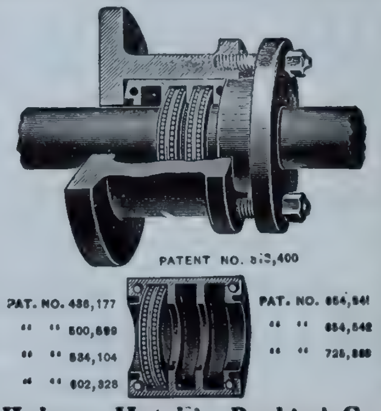
Heating Engineers and Contractors
329 King St. West, Toronto
Phone Adelaide 3669.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

HON. J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto



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HOLMES' Metallic Packing

is Guaranteed 3 years

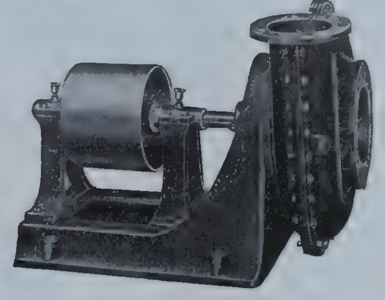
Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

A food for leather which renders it pliable and water-proof and greatly increases its wearing qualities.
Prevents cracking and keeps the leather smooth and clean.
Prevents slipping; the belt can run slack and still carry its full load, thus regular transmission of power and even running of machinery are assured.
Absolutely guaranteed. Write to-day for a package to test at our expense.

The Commercial Oil Co., Limited
Hamilton, Ont.

Why not buy the BEST when in the market for Pumping Machinery?



The SMART-TURNER MACHINE CO., Limited
Hamilton Canada

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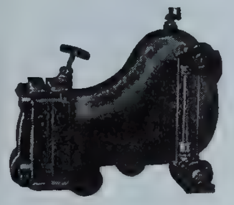
$75 A YEAR



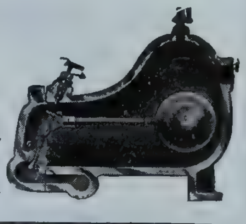
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reduciug Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
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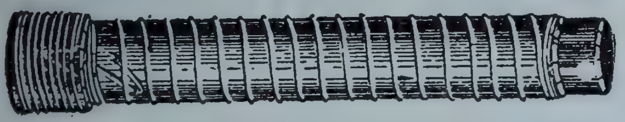

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WATERPIPES and TANKS

For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

Pacific Coast Pipe Co., Limited

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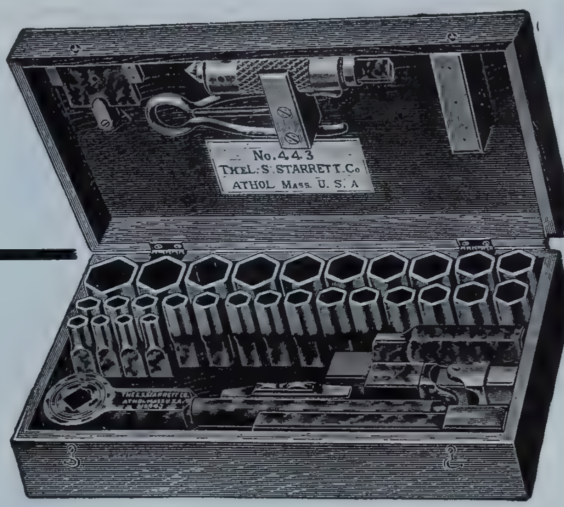
Full Particulars and Estimates Furnished



You're never cornered with a

Starrett Patent Ratchet Wrench

It will turn any standard nut or bolt in all sorts of difficult places—places where the ordinary monkey wrench is useless. The ratchet permits rapid action with only a short arc swing. The extension reaches into otherwise inaccessible places. The drilling attachment furnished with the wrench takes any twist drill from 1/8 in. to 1/2 in. A reversible screw driver makes it handy for turning screws of various sizes, too. Send for catalog No. 20CD, and see the whole Starrett line of fine tools. It's worth while.

THE L. S. STARRETT CO., ATHOL, MASS.

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THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

This Company makes a specialty of inspecting boilers under construction, and issues an official Certificate of Inspection, as required by the Laws of Ontario which came into force on the 1st July.

CONTINENTAL LIFE BUILDING
TORONTO

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Chief Engineer.

John J. Durance,
Manager.

Phone Main 6941

No Work on Sundays—

and less work the week through; boilers that steam better—and less kicks from the boss about the coal bill.

These are some of the things that happen after you have let

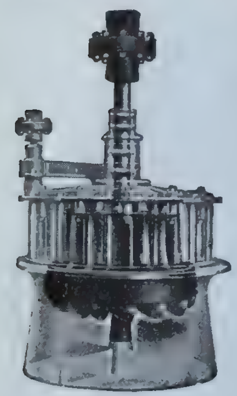
WALKER'S ELECTRIC BOILER COMPOUND

rid your boilers of scale and keep them clean. Fed in with feed-water it will accomplish this —rapidly—thoroughly, and without harming your equipment in any way.

And remember our big line of Steam Users' Supplies is worth investigating.

May we send prices?

The Electric Boiler Compound
COMPANY, LIMITED
Guelph, Ontario



For All Water Power Purposes

If you have a water power you can use, the "Samson" wheel will develop that power most economically.

The high efficiency shown by this wheel in official tests proves its economy in the use of water, and shows what the wheel will do for you when working under your conditions.

It is easily installed, and when in operation is easily controlled.

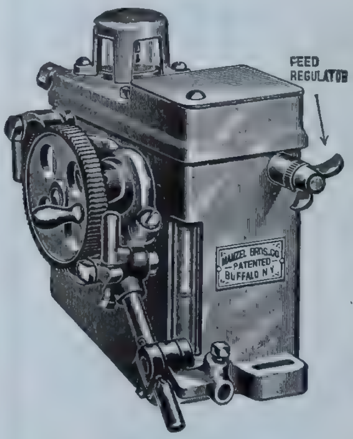
The "Samson" is always sold on an absolute guarantee.

Send for Pamphlet V.

William Hamilton Company
Peterborough, Ontario

A drop in the right Place—

and that a drop of oil — is more effective than ten drops spread about anywhere. Also it's cheaper.


FEED REGULATOR
MANZEL BROS. CO.
PATENTED
BUFFALO N.Y.

The "Manzel" sight Feed Oil Pump

by putting that drop of oil just in the right place, just at the right time, cuts your lubrication bills anything from 30% to 60%.

And the proof—let us send you a pump on 30 days' Free Trial. If it hasn't proved what we claim for it, we won't ask you to keep it.

So there's no reason why you should not ask us for it to-day.

THE TWIN CITY OIL COMPANY
General Agents for Canada
BERLIN, - - ONTARIO
MANZEL BROTHERS COMPANY, BUFFALO, N.Y.

The Detroit "500" will not syphon

The Detroit "500" Air Compressor Lubricator gives constant lubrication under every condition of service. The rate of feed never varies when changing from pressure to unloading or when returning from unloading to pressure.

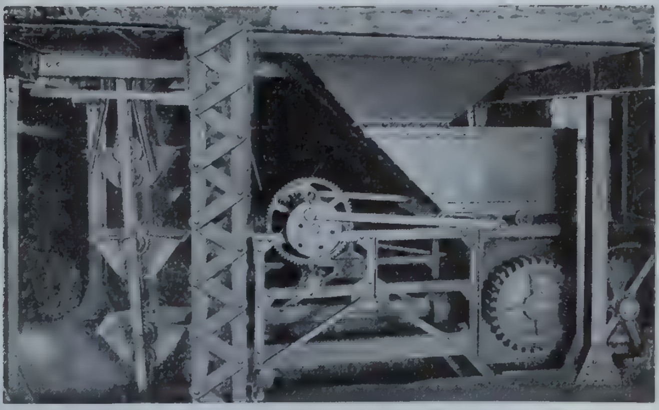
The Detroit "500" cannot be robbed of oil and cannot be affected by changing conditions in the cylinder.

This lubricator can be started and stopped without changing the feed adjustment, preventing both loss of time and oil when starting up.

The bullseye gauge and sight feed glasses are kept tight and won't break. This lubricator will withstand the roughest service.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONTARIO



Power Plant Costs are being lowered at this plant with

Jeffrey Coal and Ashes Handling Machinery

The coal is dumped into the receiving hopper in the basement. Plate Feeder with adjustable stroke delivers slack coal direct to buckets or lump coal through crusher to buckets, which deposit it in overhead bunkers.

Our New Catalog 32-B, just off the press, gives details of other interesting installations. Write for Copy.

JEFFREY MANUFACTURING COMPANY

Canadian Main Office and Works, MONTREAL

There Are Over 800 Otis Heaters in Buffalo Alone

Throughout the various states, thousands upon thousands of horse-power are in use.

Why this popularity?

Because Otis Heaters occupy a place in the engineering world that is second to none.

It is the only pressure heater made that contains an effective oil separator and cool settling chamber.

The exhaust is the heating agent, and 212° is the ordinary, not the spasmodic, temperature of the water.

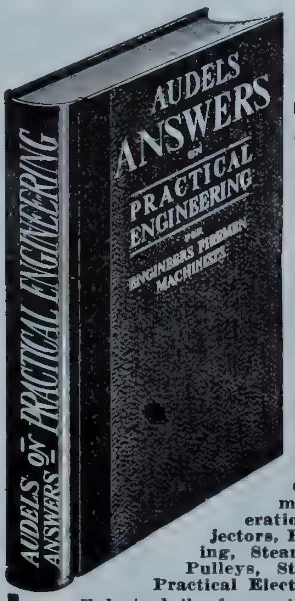
The Otis has unusually large capacity and heating surface, and is tested under 200 lbs. hydrostatic pressure.

There's a "rock-ribbed" guarantee that covers every function and part of the Otis Heater.

Try it for 30 days at our expense. You have nothing to lose, and much to gain.

Catalog on request.

Stewart Heater Company
189 Norfolk Ave., Buffalo, N.Y.



ENGINEERS

THIS book deals largely with the foundation principles which govern the practice of steam engineering. Nothing so soon condemns the applicant as want of knowledge of the every day practice and simple laws relating to the care and management of a steam plant.

No one is expected to know everything, but all are required to be familiar with certain facts which may be called "the beginning of things."

The lack of knowledge of the small things carries conviction of the same lack in the larger.

Plain facts, that you should know, are plainly explained in AUDELS ANSWERS ON PRACTICAL ENGINEERING, answers your questions on

Air, Water, Steam, Fuel and Heat, Steam Boilers, Boiler Construction, Water Tube Boilers, The Steam Gauge, The Safety Valve, Properties of Steam, Installation of Boilers, Management of Boilers, Engineers' Law, Firemen's Law, Steam Engines, The Valve and Valve Gear, The Corliss Engine, Engine Arithmetic, Lubricators, Installation and Operation of Engines, Steam Pumps, Injectors, Feed Water Heaters, Steam Heating, Steam Traps, Belts, Gears and Pulleys, Steam Turbines, Refrigeration, Practical Electricity, Elevators.

Understand the framework of which your work is but a cross bar. Know something of the cause of which your work is but an effect. Know something of the effect of which your work is the cause. And, above all, know why it is done one way and not another.

LEARN THE THEORY UNDERLYING THE WORK

PRACTICAL ENGINEERING contains 288 pages fully illustrated, handsomely bound and printed, and is in every way a first-class book.

FREE (No Duty)
EXAMINATION

Sign and mail the coupon, and it will bring to your plant a book of sterling merit, for free examination. You can have one week in which to dig out valuable information contained in its 200 or more pages.

THEO. AUDEL & CO., 72 5th Ave., NEW YORK

Please send me for examination copy Audels' Answers on Practical Engineering $1

If I keep the book I promise to send you within 7 days after receiving it ONE DOLLAR in full payment: if I do not keep it, I will mail it back to you within 7 days.

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The advertiser would like to know where you saw his advertisement—tell him.

Feed Without Pumps!

Drain *all* steam-heated surfaces in your plant of *all* condensation. Keep every inch of it dry and active. Return your condensation directly *back to the boiler* without use of steam pump or injector, and without loss of heat units contained in excess of 210 degrees— turn it into dry, hot steam, ready for *re-use.* Do all this automatically, wastelessly.

Replace every boiler feed pump in your plant with the Morehead "Back to Boiler" System. Save coal, save water—give your boiler the benefit of a large percentage of pure feed water at the highest possible temperature.

Morehead
Back to Boiler
SYSTEM

No more loss of radiating surface—no more condensation waste—no more pump troubles—

Install the "Morehead"!

Get the Catalog

Every Engineer should have it. Tells all about the handling of condensation and the Morehead "Back to Boiler" System. Very interesting.

Write for it

The operation of the Morehead System is exceedingly simple. When the drum fills with condensation, live steam is admitted to force out the water—into the boiler. No inconvenient stuffing boxes—no leaky valves—no expensive breakdowns of pumps or old-style valves. Simply installed.

Put a Morehead Trap in your plant on 30 days' trial. Write the Condensation Department for Catalog and Records of Savings and Results Obtained From Their Use.

Canadian Morehead Mfg. Co., Ltd.
WOODSTOCK, ONTARIO

102

SUPPORT HOME INDUSTRIES

THE CANADA METAL CO., LIMITED, MANUFACTURE IN CANADA

Our **BABBITT** Sales for **1913** Have Beaten All Records

Year by year they increase by Leaps and Bounds.

The Reason:

What we make we guarantee.
Nothing is done by guesswork.

Mixtures and Physical Tests are controlled through our chemical and testing laboratories. All Babbitt Metals are tested with a friction testing machine.

This strict attention to details enables us to supply all requirements.

Ask for our booklet "Shakespeare and Babbitt Metals." Mailed free.

The Canada Metal Company, Limited

HEAD OFFICE AND FACTORY TORONTO

BRANCH FACTORIES Winnipeg, Montreal

WHY USE OIL

When GREASE
Gives More
Uniform Lubrication, Is Better and
Much Cheaper?

This Grease Cup will pay for itself many times over with the money it saves in lubricants.

You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

The efficiency of this Grease Cup cannot be affected by centrifugal force when used on loose pulleys.

REMEMBER we guarantee it to save 50% over any other system.

Give it a trial and be convinced.

Write for particulars.

Peterborough Machine and
Lubricator Co., Limited
Peterborough, Ontario

Schneider & Helmecke, Magdeburg Germany

RETURN STEAM TRAP FOR FEEDING BACK HOT

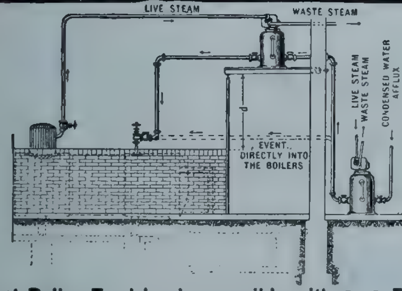
Founded A. in 1878
Export

GREAT SAVING IN COALS AND WORKING EXPENSES.
INCREASED BOILER EFFICIENCY.
INCREASED LIFE OF BOILER.
MINIMUM OF BOILER INCRUSTATION.

SCHNEIDER & HELMECKE-MAGDEBURG
Special Works for Steam Traps

CONDENSED WATER DIRECT TO BOILER, WITHOUT PUMP.

THE MOST RATIONAL

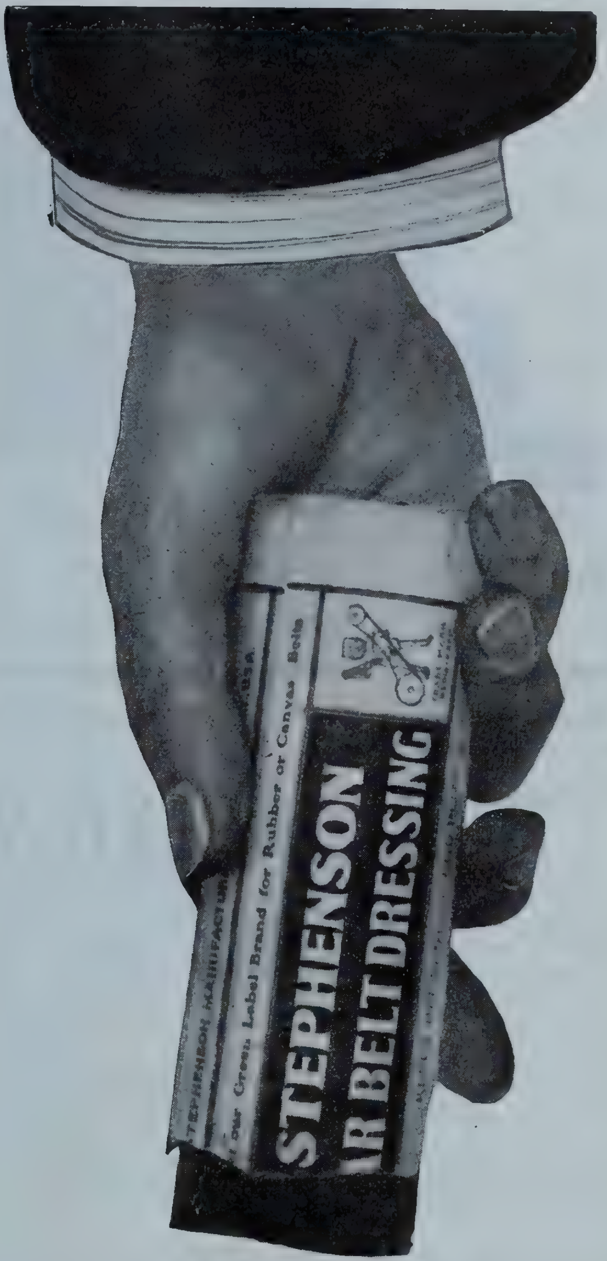


SELF-ACTING BOILER FEED

Direct Boiler Feed is also possible with **one** Return Steam Trap according to the situation.

Dominion Sugar Company, Ltd. We received your favour of the 5th inst. and noted its contents. To our great satisfaction we are able to inform you that your Return Steam Traps, are working excellently. We have now installed all four, which have worked faultlessly right away from the commencement. — One double Return Steam Trap suffices for conveying the condensed water from 6 Sperber drying apparatus directly back to the boilers. — *Since the Return Steam Traps were installed the feed pump for the boilers of the splitting-drying department has not been used.* — The saving in coals is considerable, since by aid of the Return Steam Traps we can now easily keep up full steam, whereas previously we had constantly to force the boilers to the utmost. After the experience gained with your condensed water Return Steam Traps we must admit, that no plant ought to be without the same. The feed pump has always been a unisance to us.
We leave it to your discretion to make whatever use of this you please.
Wallaceburg (Canada), Ont., Novbr. 22 nd, 1909.

YOURS FREE!



You can have this Half Pound Stick of Stephenson Bar Belt Dressing Free for the asking. Simply write us "Send sample as advertised in "Power House," and it will come direct by Parcel Post. You will find it the best belt dressing made, the easiest, cleanest and quickest to apply; the longest lasting and the surest in results. For twenty-five years Stephenson Bar Belt Dressing has stood the test.

Write for this sample—try it and see why.

Sold by reliable dealers in Canada.

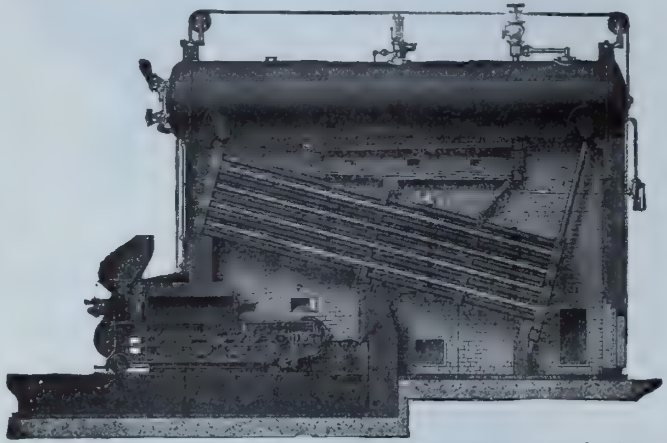
Stephenson Manufacturing Co.
Albany, N. Y.

BABCOCK & WILCOX, Limited

"B.&W." PATENT WATER TUBE STEAM BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 10,000,000 H.P. IN USE



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

Our Book "STEAM" sent on request

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BOILER FEED WATER TROUBLES

Corrosion, Pitting, Foaming, Scale Formation, due to the mineral elements in the water—cannot be overcome by any "Cure-all" method.

Definite knowledge of the nature of the water,—obtained by analysis,—is essential in setting about to correct these conditions. The proper reagents must be provided in the treatment to counteract the injurious minerals found in the water, and reagents must be used that will not form in combination by-products that will prove injurious to the boiler metal.

Dearborn Treatment

is prepared according to these scientific principles,—and the desired action is assured. **Your inquiry will have our immediate attention.**

Dearborn Chemical Company of Canada, Limited
TORONTO, CANADA
Office, 705 C.P.R. Building. **Factory, 1220-1230 Dundas Street.**

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International Engineering Works, Ltd., Amherst, N. S.
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Hare Eng. Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
International Engineering Works, Ltd., Amherst, N. S.
Nobis Engineering Co., Toronto.
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John McDougall Caledonian Iron Wks, Montreal.

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Gauges, Water.
Jenkins Bros., Ltd., Montreal.
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Ohio Brass Co., Mansfield, Ohio.

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Smart - Turner Machine Co., Ltd., Hamilton.

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Siemens Co. of Canada, Ltd. Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
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W. H. Allen Son & Co., Bedford, Eng.

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Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
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Governor, Water Wheel.
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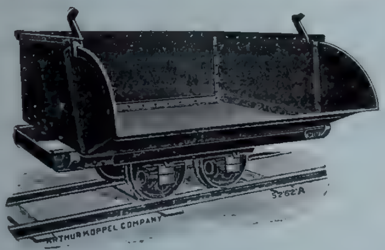

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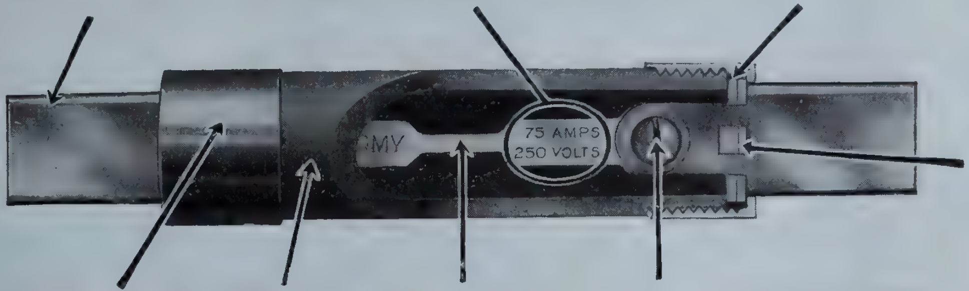

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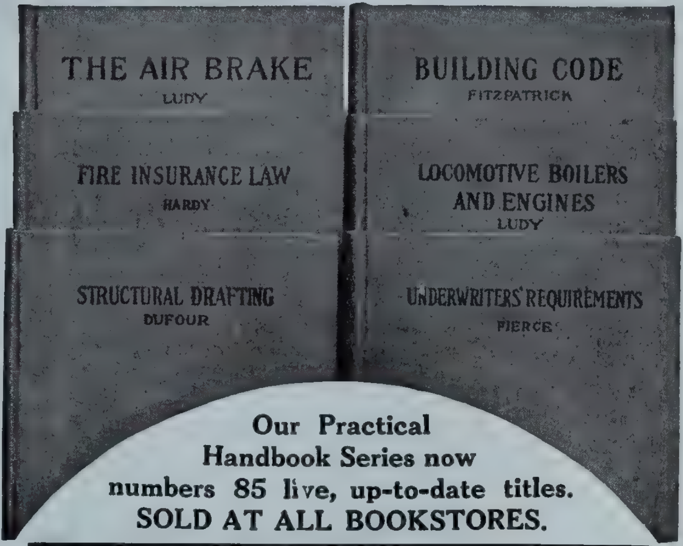

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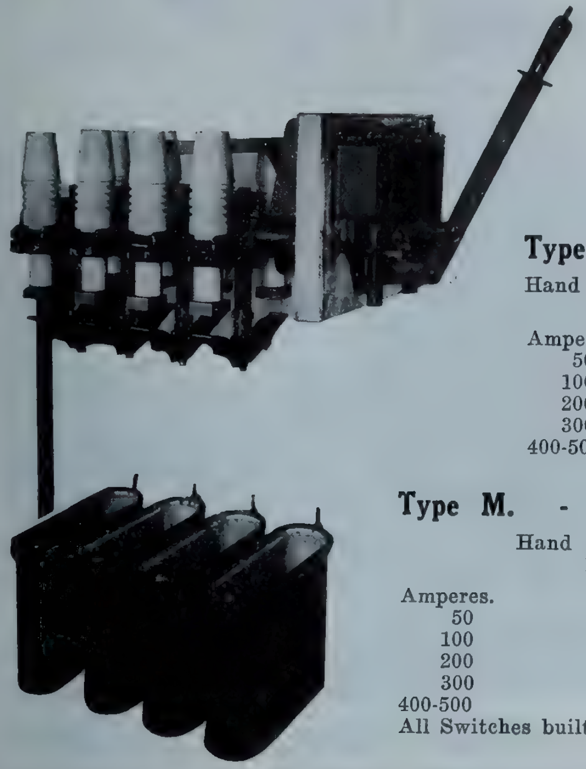

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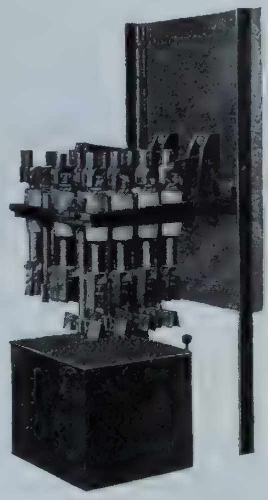

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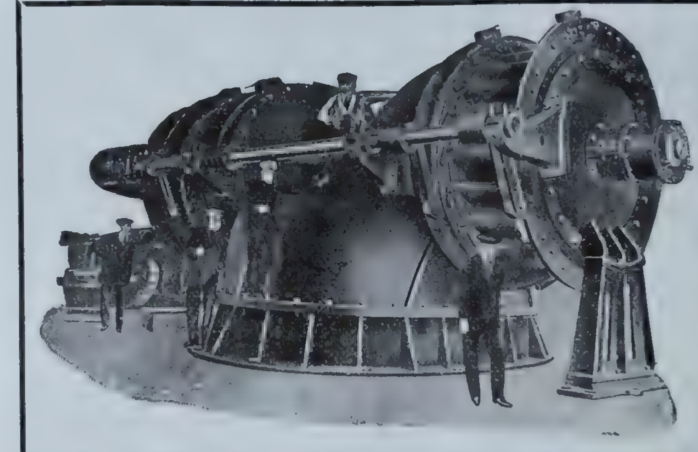

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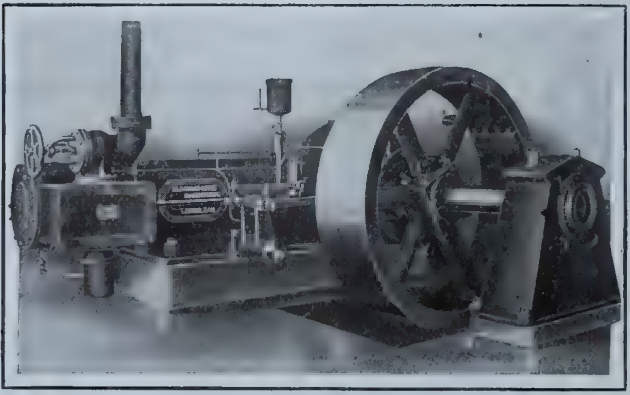

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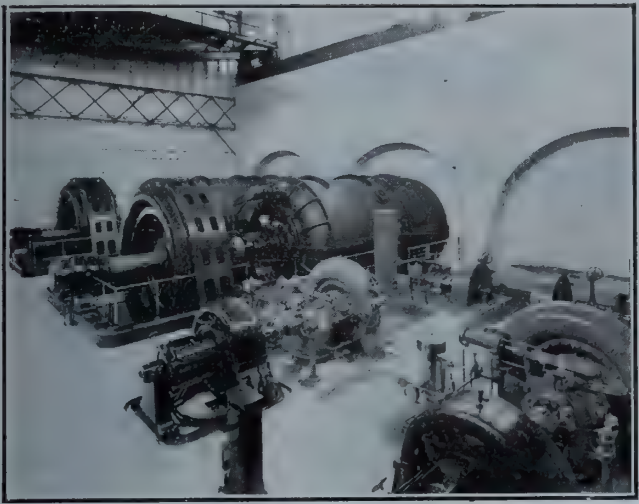

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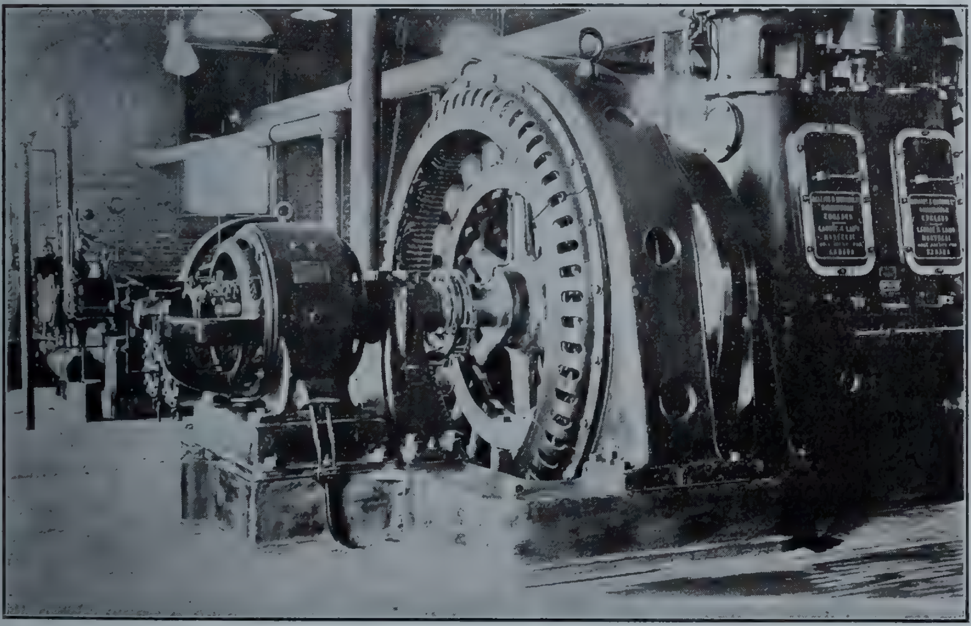

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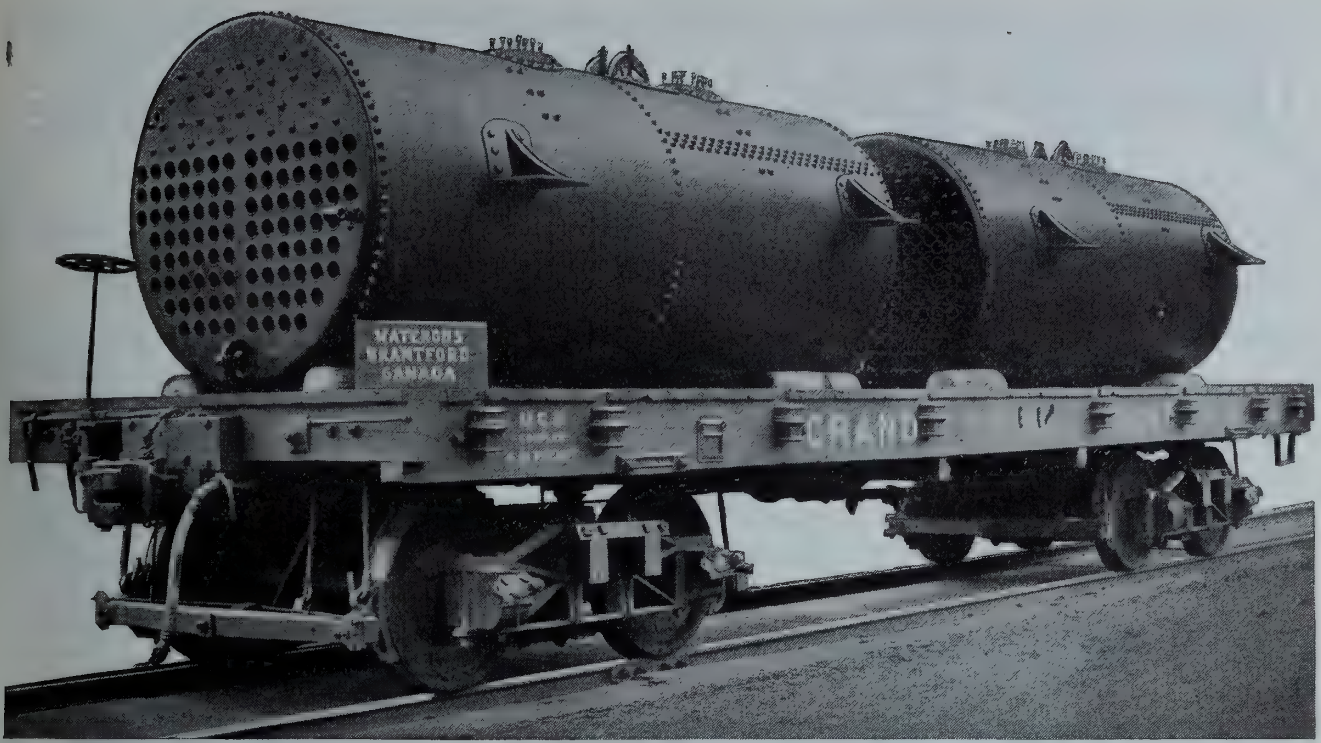

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We build and carry in stock Return Tubular Boilers up to 72" x 18'. If we cannot supply you at once from our yards we can turn out your order in quick time. Ask us for prices on the next boiler you buy.

Some Recent Installations

Canadian Pacific Railway, Calgary, Alta.	2—60"x14'
Okanagan Sawmills, Enderby, B.C.	2—66"x14'
Lake Superior Iron & Steel Co., Sault Ste. Marie	5—72"x18'
Corporation of Orangeville.	1—54"x14'
Dominion Canners, Simcoe.	3—72"x18'
Grand Trunk R.R., Montreal	2—72"x18'
Steel Co., Ltd., Hamilton.	2—72"x18'
Dunlop Tire & Rubber Goods Co., Toronto	1—72"x18'
Imperial Oil Co., Ltd., Sarnia	5—78"x18'
M. Oldfield & Sons, Grimsby	2—66"x16'
Canadian Westinghouse, Hamilton	2—48"x14'

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA

Dunham Vacuum Heating Systems

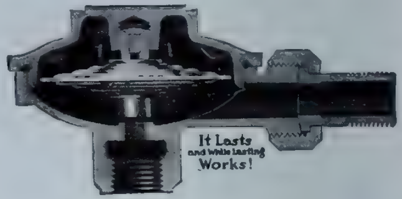
This heating season will not last much longer, but it has probably been long enough even now for you to discover many things about your system which are unsatisfactory. Your troubles can be eliminated by using a good vacuum system of heating.

So first of all investigate a Dunham Vacuum Heating System. You'll find that it:—

¶ Eliminates air binding in the radiators.
¶ Does away with the use of air valves, which either sputter and spit steam and water over everything or keep the air in the radiator.
¶ Permits circulation through every radiator in your office or plant at a pressure of not more than one pound.
¶ Eliminates all water hammer and consequent annoyance from that source.
¶ It eliminates freeze-ups.
¶ It saves money in repairs and actual fuel consumption.
¶ It prohibits the loss of steam into the return lines.

Get busy early and secure estimate on changing your system over this spring or summer. The saving next winter in time and fuel will pay half the expense.

THE DUNHAM RADIATOR TRAP performs the functions of a Radiator Steam Trap perfectly and continuously. Eliminates water and air without loss of steam. Write us for particulars and Bulletins.



C. A. DUNHAM CO., Ltd., TORONTO, CAN.

Halifax Montreal Winnipeg Vancouver Calgary Ft. William

Frost King Babbitt Metal

Is the result of 35 YEARS' EXPERIENCE in metal mixing and we believe it is absolutely perfect.

For high-speed machinery and engine work it is without an equal. It is specially designed for Saw Mills, Planing Mills, Threshing Engines, Traction Engines, Pumps, Rolling Mills, and Pulp Machinery, and all classes of stationary engines.

If your dealer does not stock "FROST KING" write us and we will take pleasure in making you a shipment of a 25-pound box.

OUR MIXED METAL SALES AMOUNT TO $5,000,000 ANNUALLY.

Hoyt Metal Company, Toronto, Ont.

FACTORY AND OFFICE:—Eastern Avenue and Lewis Street

New York, N.Y. London, Eng. St. Louis, Mo.

JENCKES BOILERS

HORIZONTAL TUBULAR
VERTICAL TUBULAR

LOCOMOTIVE TYPES
HEATING BOILERS

Maximum Results *Minimum Repairs*

If you contemplate installing a new boiler it will be to your interest to investigate the product of our Boiler Department. We'll gladly put you in touch with users.

Perfect workmanship; high-grade material and careful attention to details are characteristics that have made the Jenckes Boilers famous.

Jenckes Boilers conform to the various Provincial Inspection Acts. Every one is subject to rigid test under high pressure before leaving the works.

Write for Catalog

The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Cobalt South Porcupine Nelson Vancouver
Works: SHERBROOKE, QUE. ST. CATHARINES, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

POTATO SCALE

BOILER CLEANSER

Would you feed your boilers on dollar bills? Would you order your firemen to fill up the stoker hoppers with nice, clean "greenbacks" fresh from the bank?

Of course you wouldn't!

You'd know that a dollar will purchase a great deal more calorific value in coal than it will give as feed under a boiler.

You wouldn't do this—you're a sane business man—yet you allow your boilers to accumulate scale that effectually prevents all but a small percentage of the heat you get out of your coal, from reaching the water it's intended for.

And you grouch at the cost, and go on "feeding with dollar bills."

Potato Scale Boiler Cleanser goes right to the root of this scale trouble—the feed water. Fed into your boilers in the manner and quantity we prescribe, it will quickly clean tubes and sheets of all adhering scale. And its continued use will prevent any new scale forming.

Send for a keg now. We guarantee it.

But do it now. Dollar bills aren't so very plentiful.

We sell 4 kinds of BOILER GRAPHITE
Get our prices.

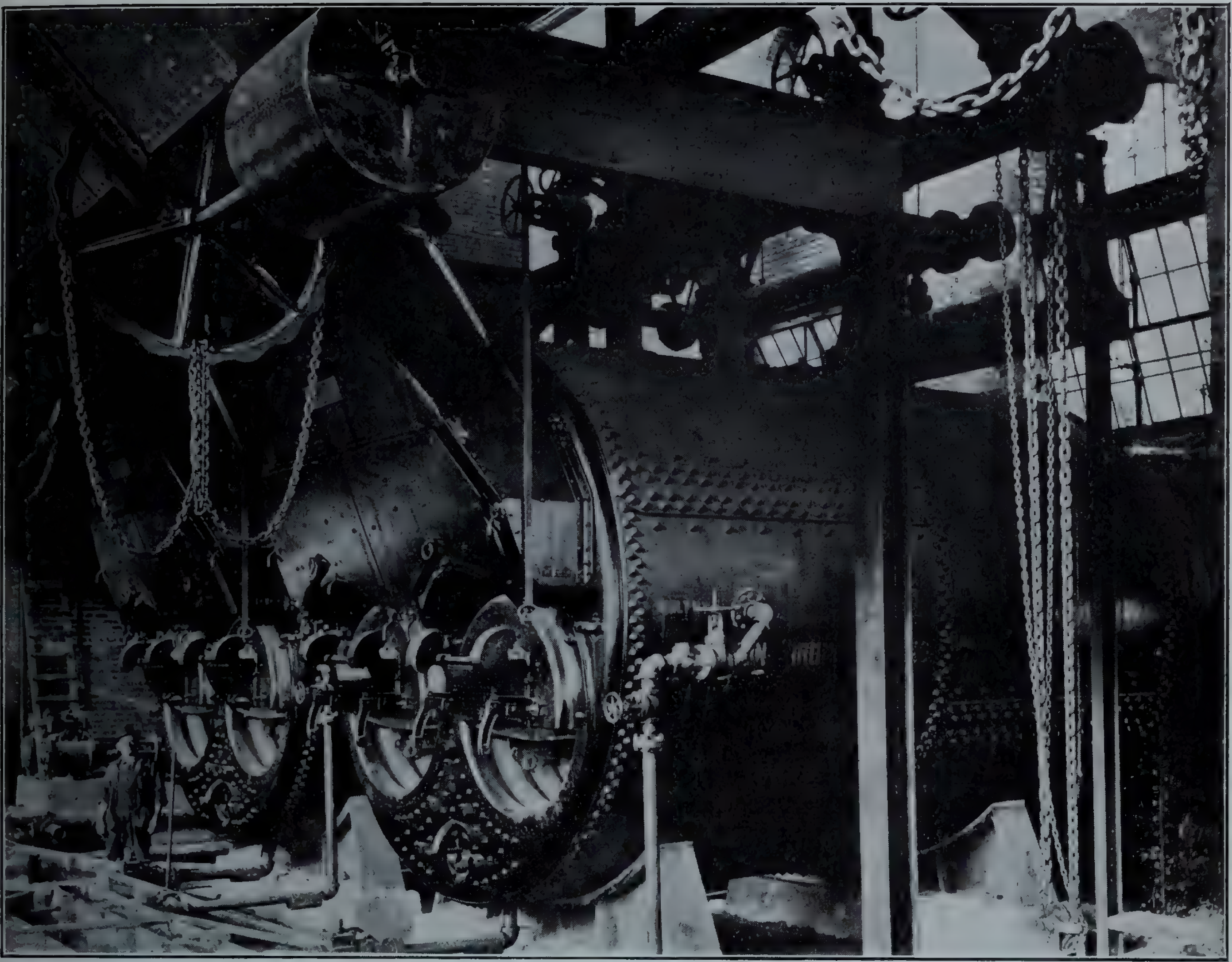
C. C. SNOWDON

1810 - 1840 11th STREET EAST, CALGARY, ALBERTA
P.O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches :— Edmonton Winnipeg Vancouver



REPEAT ORDERS TESTIFY

to the reputation that "**Polson**" **Boilers** have gained for correctness of design, construction and general all-round efficiency; to the number of satisfied users who are content to put their steam-raising problems up to the Polson Iron Works; to the high esteem in which they are held by engineers all over the country.

These two boilers were built to fill a repeat order from the Consumers' Gas Company, Toronto. They are of the return-tubular dry back type, each 11 ft. 6 inches diameter, and 15 ft. long. They are fitted with Morrison Furnaces and Adamson Furnaces with Galloway Tubes.

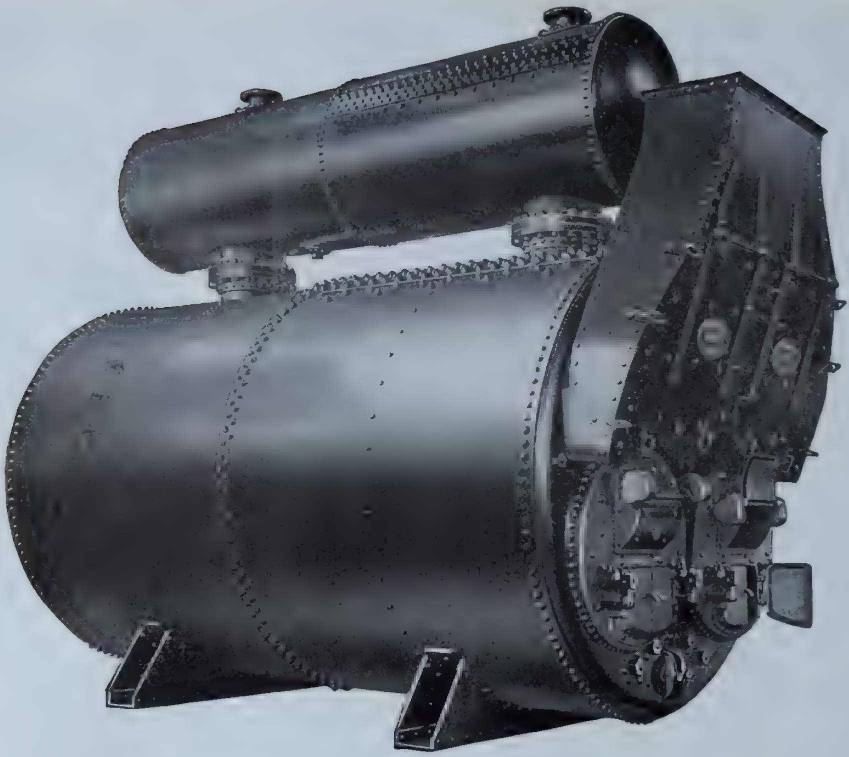
How about your boiler problems? We can give you the same service.

Polson Iron Works, Limited

Toronto, Ontario

Representatives in Canada for

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, Eng., Marine Motors



No Leaky Brick Setting

Did you ever spend hours, perhaps whole days, picking out the old mortar from between bricks, re-pointing, painting porous bricks, and patching up loose door frames?

If so, you would like the

Robb-Brady Scotch Boiler

It has no brickwork. There can be no infiltration of air to dilute and cool the gases.

It is internally fired; the gases are completely surrounded by water-heating surfaces from the time they leave the grates until they reach the uptake. But it is different from other internally-fired boilers—the water doesn't stand still, it circulates rapidly and positively, sweeping the heating surfaces clean, insuring rapid and economical steaming.

There's no flat-top combustion chamber to worry about or clean, no girder stays or crown bars. Short-screwed stay bolts only are used and the tube sheet and back inside head are not called on to support crown bars.

How the Robb-Brady boiler secures rapid circulation without a pump or other external device is explained in Bulletin No. 7. Send for it.

INTERNATIONAL
ENGINEERING WORKS, LIMITED

SO. FRAMINGHAM, MASS. **AMHERST, N.S.**

Montreal **Winnipeg** **Edmonton** **Toronto** **Vancouver** **Calgary**

39-67

Perolin

Harmless to Metal

GUARANTEE

We guarantee PEROLIN, the German Boiler Metal Treatment.

1. To loosen scale already formed in the boilers by its mechanical action;

2. To Prevent New scale from forming;

3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;

4. To correct troubles caused by oil and grease getting into the boiler water;

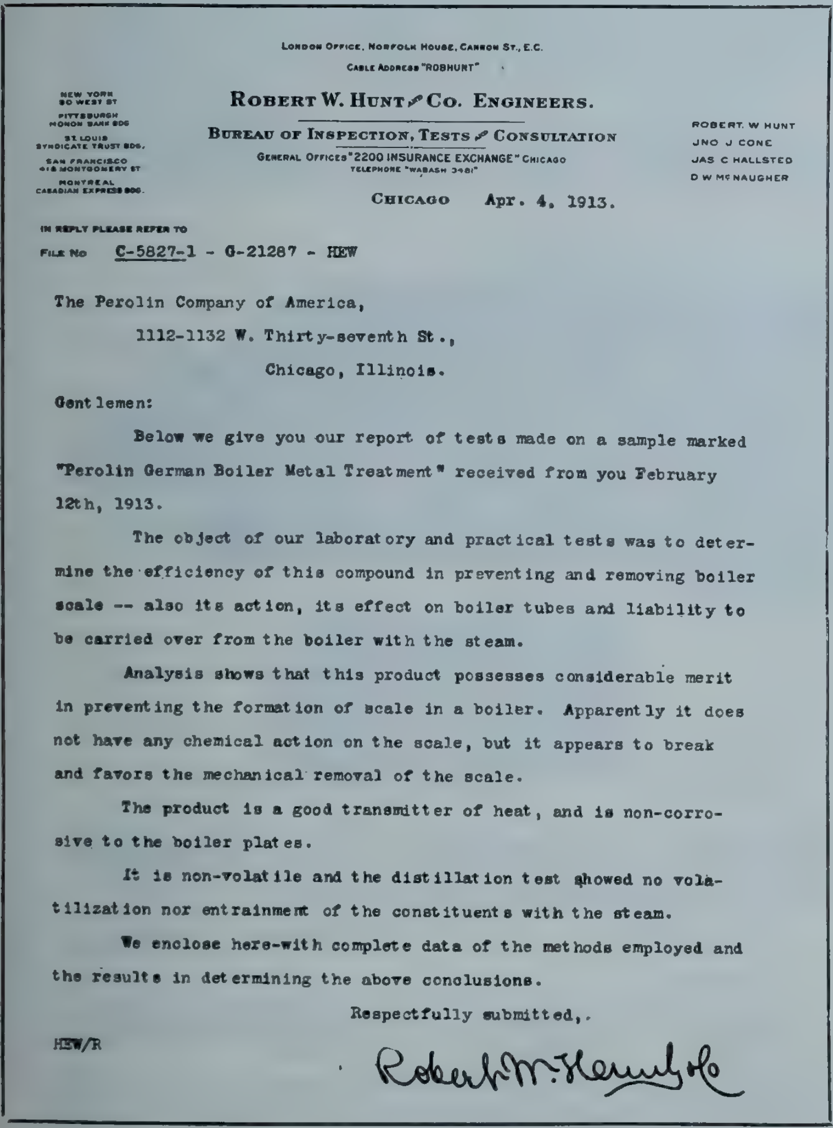
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;

6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;

7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;

8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

The Bureau of Inspection, Tests and Consultation SAYS—



London Office, Norfolk House, Cannon St., E.C.
Cable Address "ROBHUNT"

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Robert W. Hunt & Co. Engineers.

Bureau of Inspection, Tests & Consultation

General Offices "2200 Insurance Exchange" Chicago
Telephone "Wabash 3481"

Robert W Hunt
Jno J Cone
Jas C Hallsted
D W McNaugher

Chicago Apr. 4, 1913.

In reply please refer to
File No C-5827-1 - G-21287 - HEW

The Perolin Company of America,
1112-1132 W. Thirty-seventh St.,
Chicago, Illinois.

Gentlemen:

Below we give you our report of tests made on a sample marked "Perolin German Boiler Metal Treatment" received from you February 12th, 1913.

The object of our laboratory and practical tests was to determine the efficiency of this compound in preventing and removing boiler scale -- also its action, its effect on boiler tubes and liability to be carried over from the boiler with the steam.

Analysis shows that this product possesses considerable merit in preventing the formation of scale in a boiler. Apparently it does not have any chemical action on the scale, but it appears to break and favors the mechanical removal of the scale.

The product is a good transmitter of heat, and is non-corrosive to the boiler plates.

It is non-volatile and the distillation test showed no volatilization nor entrainment of the constituents with the steam.

We enclose here-with complete data of the methods employed and the results in determining the above conclusions.

Respectfully submitted,

HEW/R

Robert W. Hunt & Co

Why not draw this to the attention of your employer? It is not a boiler compound—it's a **German Metal Treatment** that **loosens** old scale so that it can be readily removed. It forms a preservative film over the tubes when old scale is removed—this film prevents scale-forming substances from adhering, is a good transmitter of heat and prevents pitting, corrosion, etc.

"Perolin" will save you much time and labor, and your employer much fuel and trouble.

Call his attention to it now—get him to order a trial quantity. The results will be pleasing to you both, and you will be in a better position for a **raise in salary**.

Perolin Company

of Canada, Limited

76 Adelaide St. W., Toronto, Ont.

"THE Cyclone"

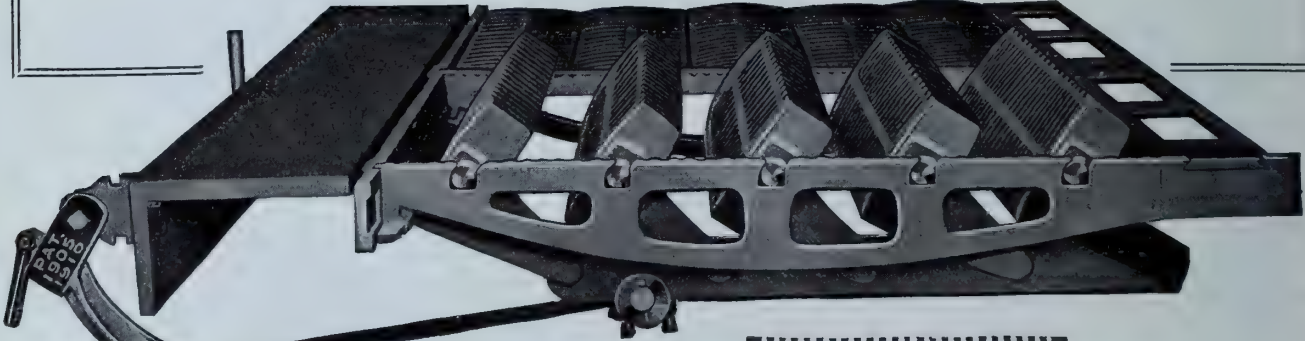
Shaking and Dumping Grate Bar

enables the engineer to fire light and cut off the ash without letting unburned fuel through, with the fire doors closed.

The "Cyclone" allows 68 per cent. of air space and 90 per cent. underdraught.

The combustion is so perfect that the cheapest grades of fuel can be used with equal to that of the best. This means a **big saving of fuel.**

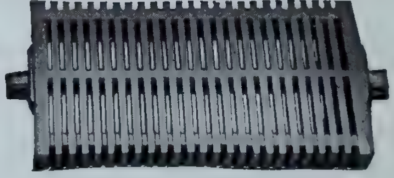
Locks level. Cannot get out of adjustment or become warped. Cyclone Grate Bars are fully guaranteed in every respect—and they live up to our claims everywhere. **Users will tell you too.** May we get you in touch with some of them?



BEWARE OF IMITATIONS.

There are imitators who claim that their gates are as good as the "Cyclone."

If any of them pay you a visit ask them to prove it—they can't.



The Canadian Steam Boiler Equipment Co., Limited

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: TORONTO, CANADA

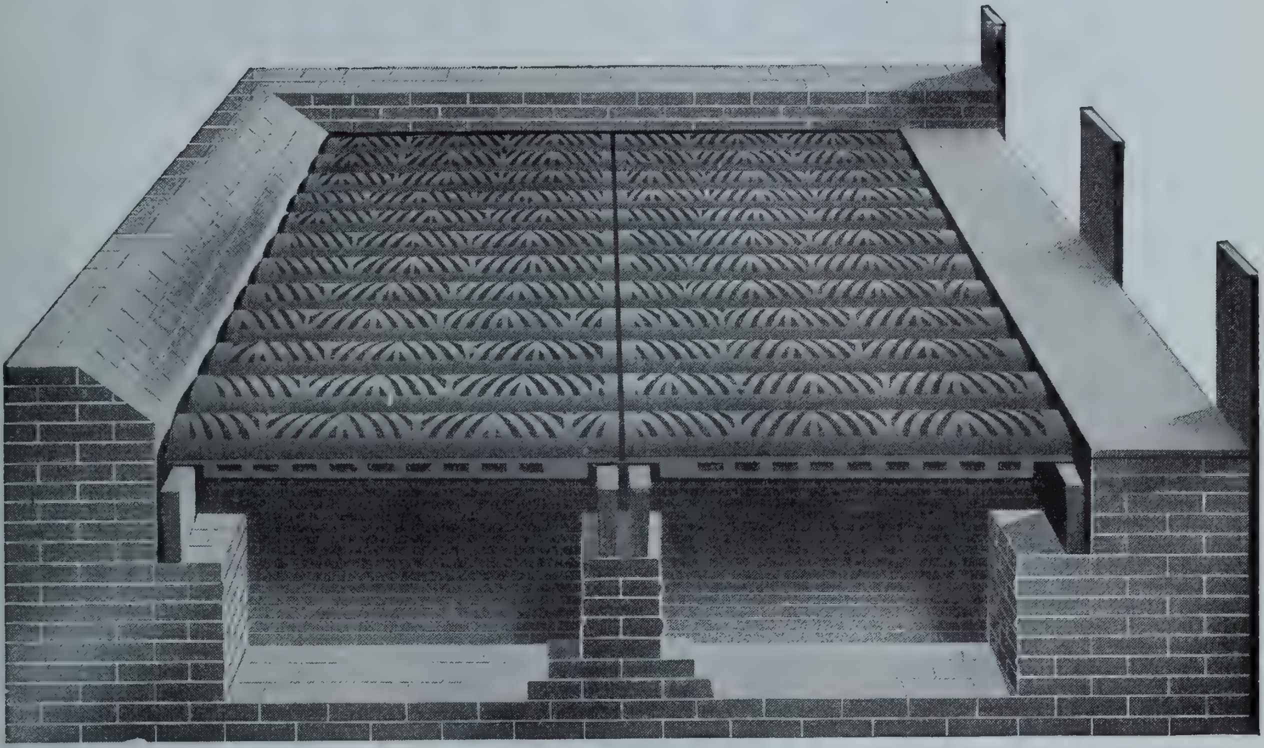
AGENTS

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS— PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

Stop Blow-outs and Leaks in Pipe Lines by Using GOETZE No. 2 ELASTIC GASKETS

If you start right now to renew with No. 2 ELASTIC GASKETS, you can steadily reduce your renewals until you have brought them almost to the vanishing point.

This is not a mere "claim"—it is backed up by a *guarantee*—in fact the strongest guarantee ever made by a gasket manufacturer.

Think what it means to re-gasket a joint so it will *keep tight for years,* instead of days or weeks. Think of the saving resulting in gasket costs, labor and shut-downs.

What No. 2 Elastic Gaskets Will Do

No. 2 Elastic Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight. Prevent leaks, blow outs and shut-downs. Will practically eliminate renewal expense for gaskets.

No. 2 Elastic Gaskets are for high pressure and super-heated steam lines, but owing to their indestructible nature, are equally adapted to *any and every condition* about a factory, mill or refinery.

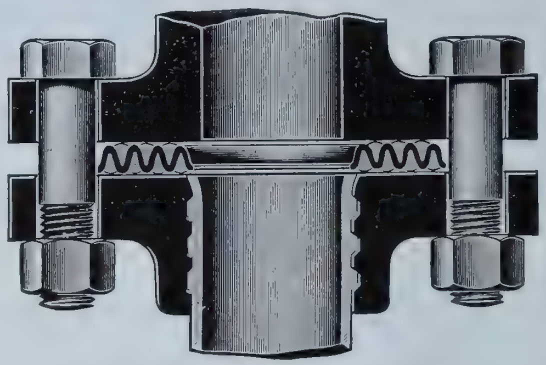
The No. 2 Elastic Guaranteed

Every No. 2 Elastic Gasket is Guaranteed for 5 Years' Continual Service in the Same Joint

There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every No. 2 Gasket whether bought direct from us or through a dealer.

How No. 2 Elastic Gaskets are Made

These Gaskets are made of corrugated copper with asbestos lining No. 2. The corrugations allow for expansion and contraction of the pipes, while the asbestos, being forced into the pores of the metals in the flanged surface by the "squeeze" and the constant pressure of the corrugations beneath it, holds securely against the highest pressures.



Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

ST. JOHN, N.B.

BRANCHES AT

MONTREAL	TORONTO	WINNIPEG	LETHBRIDGE, Alta.	VANCOUVER
112 St. Peter St.	Mills Bros., 809 Lumsden Bldg	C. E. Chown, 425 Henry Ave.	J. B. Turney & Co.	c/o A. O. Campbell, 626 Pender St.

MANUFACTURED BY

Goetze Gasket & Packing Co., New Brunswick, N.J.

TESTED PACKNGS

FOR EVERY PURPOSE

THIS PAMPHLET is an authentic text-book—a complete illustrated guide—to standard lines of tested packings.

We shall be glad to send you a copy, gratis.

Canadian Consolidated Rubber Co., Limited
MONTREAL

Please use this coupon ☛

Canadian
Consolidated
Rubber Co., Limited
Montreal

Gentlemen:

Please send me a complimentary copy of "Tested Packings for Every Purpose."

Name ....

Address ....

....

Theory and practice, science and experience all agree that on the common point that a solid rod packing or a badly-constructed one of any other type cannot prevent friction. There is common agreement also on the fact our self-setting, sliding-wedge packing does save 80 to 90 per cent. of friction.

DANIEL'S ROD PACKING

P. P. P.

COIL RING SPIRAL

What Mechanical Engineers Say

"Tests showed that it required **fifty per cent. more frictional horse-power** to run an engine with high-grade (solid) ring packing than required to run it with P. P. P., and **fifty-nine per cent. more frictional horse-power** to run it with gum-core packing than with P. P. P. Packing, effecting a saving by the use of P. P. P., in the case of the high-grade ring packing of 1.96 horse-power, and a saving over the gum core of 2.31 horse-power."

If you are using solid ring packing or gum core and know the cost per horse-power per annum in your plant, you can easily figure the sum P. P. P. Packing would save in your fuel account each year.

What Operating Engineers Say

"I am using Daniel's P. P. P. Packing with good results. Have tried several kinds but none equals P. P. P."

"I find after using several different kinds of packing on our Corliss engine that P. P. P. is the only one that stands the test."

"I am a stationary engineer and having run all kinds of engines, during my experience packing these engines, I have used most every packing known, and to my satisfaction, I have found P. P. P. Rod Packing the best I have ever used. I also find that P. P. P. cuts out most of the Sunday work, packing engines."

Your dealer ought to carry P.P.P.—if he doesn't, write and we will tell you who does.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, Pa., U.S.A.
629 Market St.

Escaping Steam

means money going to waste and more packing to be used.

Why Not Use

a rod packing made to give long, economical service under up-to-date conditions?

"PALMETTO" PACKING

REG. TRADE MARK

gives long service under high-pressure, superheated steam because it is made entirely of mineral substance that carries its own lubricant in such a way as to insure its remaining soft and pliable in service—THAT MEANS ECONOMY.

May we send you a free working sample to prove the economy of "Palmetto"?

Greene, Tweed & Co.
Sole Manufacturers
109 Duane Street,
NEW YORK

Canadian Distributing Agents, The Canadian Fairbanks-Morse Co., Ltd., Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

BOWSER
ESTABLISHED 1885

Central Oil Clarifying System

The Bowser Gravity Tank

Illustration to the left shows the Bowser overhead gravity tanks fitted with wall indicators and equipped with high and low level electrically operated alarms. The oil is automatically controlled by a pump governor to any level.

These overhead tanks have sufficient capacity to keep the entire Woolworth Building Power Plant supplied with oil for eight hours' time.

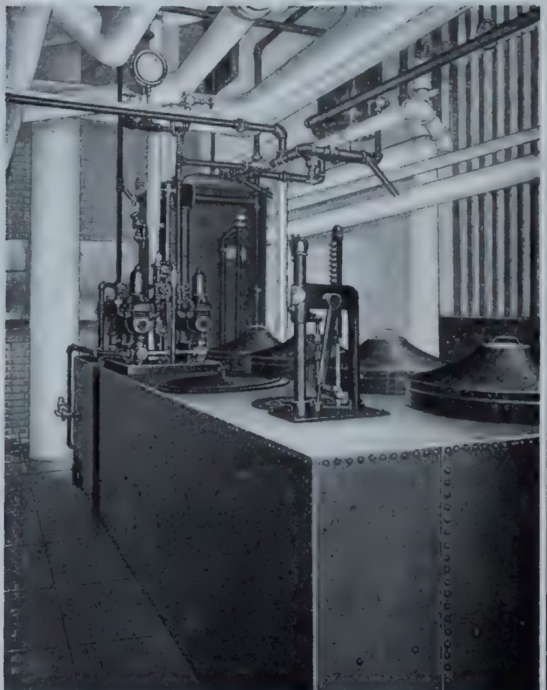
View at the right shows engine room and method of concealed piping. Not a drop of oil is wasted and the friction is cut down to the minimum. Every working part of the machinery is flushed with oil—no part is neglected.

A Bowser system of the proper size will pay for itself in its saving of oil alone in a comparatively very few months' time and its upkeep is negligible.

The Bowser 2F4 Type Oil Clarifying System

The Bowser Oil Clarifying System is placed in the basement of the Woolworth Building below the lowest bearing so that the oil will run to the filter system by gravity. First the oil is heated and separated from the entrained water, which is ejected automatically; then the oil passes over a series of precipitating trays through the filter section and is stored ready for use.

It is recognized by the highest engineering authorities that the "squirt-can-oil-hole" method is antiquated, wasteful, disastrously insufficient in supplying lubricant and in its insufficiency causes many shut-downs and delays that could be avoided by installing either a Bowser Central Oil Filtering and Clarifying System or a Bowser Individual Oil Clarifying Unit.



As installed in the Woolworth Building New York

A Bowser Oil Filtering and Circulating System is the logical oil clarifying device for the engineer, because it is complete and comprehensive in construction and *simple* in operation. It is built upon the "Dry System" and is Bowser-made throughout—

Bowser-made Filter,
Bowser-made Fittings.
Bowser-made Pump.
Bowser-made Castings, in fact everything is made in the Bowser factory. That is one reason why the Bowser blanket guarantee assures you that every part will work properly.

The Bowser Line

We manufacture *Central* or *Individual Oil Clarifying Devices* with capacities from 5 to 7000 gallons or more of filtered oil per day.

We will install a complete Central Oil Clarifying System and turn it over to you in service or we will furnish you an Individual Outfit, or the filter only, or each system complete with instructions how to erect it.

Remember the name "Bowser" has been before the public for over 29 years and has over a million users and boosters behind it.

An inquiry will not obligate you in the least, and may assist in solving that oiling problem.

Made by Canadian Workmen
Sold by Canadian Salesmen

S. F. BOWSER & CO., Inc.,
Engineers and Manufacturers of Oil Handing Devices

66-68 Frazer Ave.
TORONTO, ONT., CAN.

Sales Offices in all Centres and Representatives Everywhere. Original patentees and manufacturers of standard self-measuring hand and power driven pumps, large and small tanks, gasolene and oil storage and distributing systems, self-registering pipe line measures, oil filtering and circulating systems, dry cleaners' systems, etc.
Established 1885.

When You Order

HIGH PRESSURE JOINTING

Specify

GARLOCK HOLDTITE

Because,

"Holdtite" will stand a varying temperature up to 572° Fahr. Has a tensile strength of 3 tons per square inch and stands a comprehensive strain of 14 tons and still retains it elasticity.

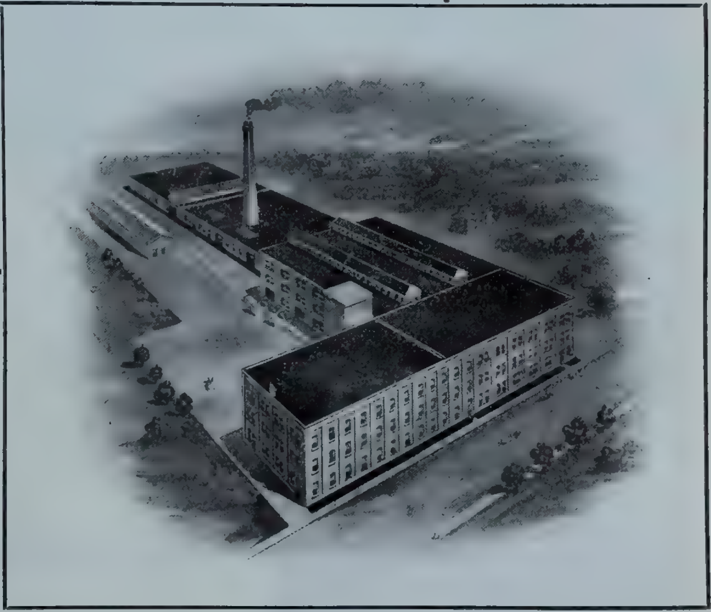
Put up in Sheets 40-in. x 40-in. in 1-32-in., 1-16-in., 1-8-in.

Write for sample and interesting information.

THE GARLOCK PACKING CO.
HAMILTON, ONT.

Montreal Toronto Winnipeg Calgary

"Pioneers in the Packing Business — and Specialists"



Works at Hamilton

Look for the Diamond Trade-Mark!

It's the first rule in good valve buying.

The universal reputation of our products, resulting from over forty years' experience, has naturally encouraged imitations. It is, therefore, highly important that proper care be taken to make sure that the recognized trade-mark of JENKINS BROS. appears on all goods claimed to be of our manufacture.

TRADE
JENKINS
MARK
Jenkins Bros

Have your orders read

"GENUINE
Jenkins Bros.'
VALVES

and see that you get them.

They will improve the efficiency of your plant.

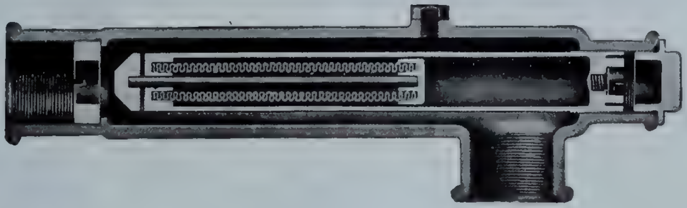
Stocked by dealers everywhere.

Catalogue sent free on request.

JENKINS BROS., Limited

103 St. Remi Street MONTREAL

We Promise to Give You Surer Trapping At But One-Third The Cost

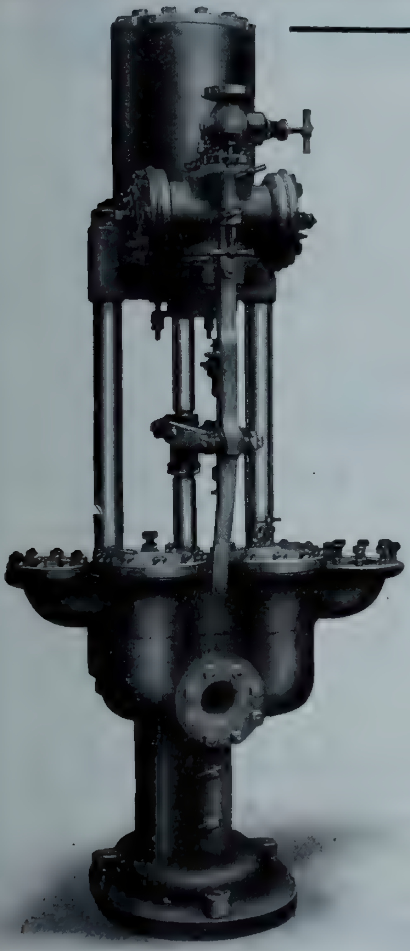


THE **SARCO** Steam Trap is radically different from any other type made. It is the SIMPLEST and the LOWEST PRICED on the market, yet it is tremendously *effective.* A Sarco is a SURE trap.

Over a QUARTER OF A MILLION now in use.
We'll Send You A Sarco To Give A Try-out

Send for price list and leaflet No. 5

PEACOCK BROTHERS
MONTREAL VANCOUVER



"WEIR"

THE UNSURPASSABLE PUMP

THE GREATEST EFFICIENCY. THE GREATEST ECONOMY.
Over 50,000 now in use.
Feeding Upwards of 120,000,000 Horse-Power

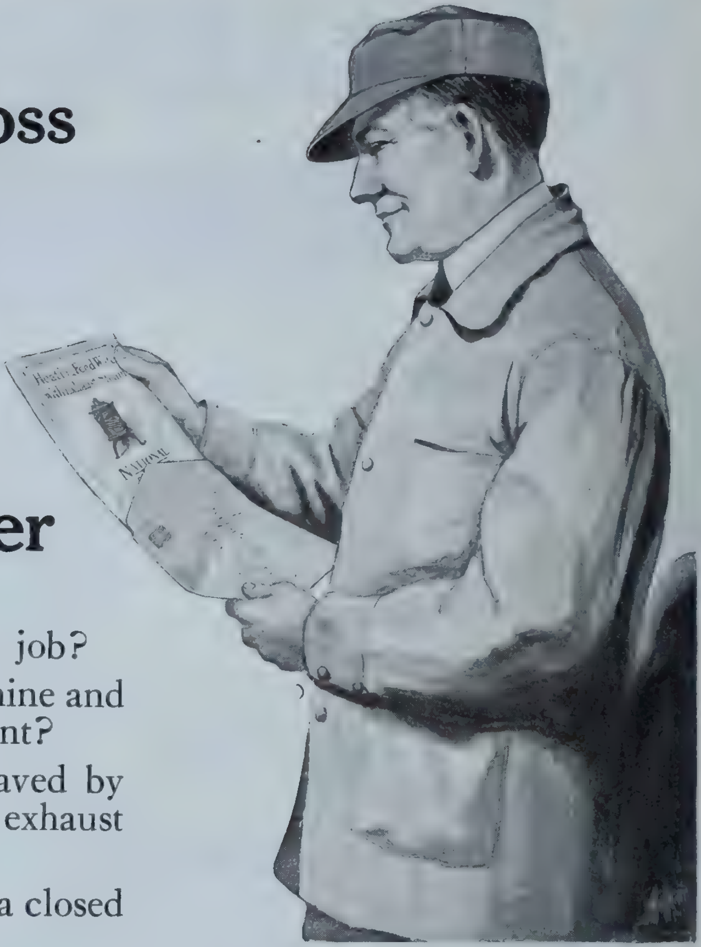
The Largest Vessel in the World,
The Largest Battleship in the World,
The Most Powerful Battle Cruiser,
The Fastest Torpedo Boat Destroyer,
The Most Luxurious Yacht Afloat,
The Greatest Dredger,
Are all fitted with WEIR AUXILIARIES.

The largest and most up-to-date plants in Canada are all equipped with

Weir Feed Pumps

List of Canadian users sent upon application.
Send for catalogue No. 4.

SOLE AGENTS
PEACOCK BROTHERS
Montreal Vancouver



When the Boss Needs a New Chief Engineer

will you be able to take the job?

Can you operate every machine and all the apparatus in the plant?

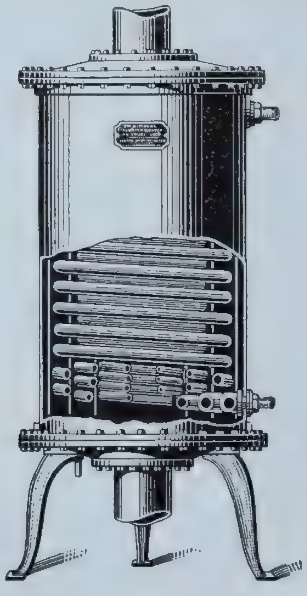
Can you figure the coal saved by heating the feed water with exhaust steam?

Can you tell whether to use a closed or an open heater?

Do you know how big the heater should be?

Do you know how to pipe up both primary and secondary heaters in a condensing plant?

Be perfectly honest with yourself. If you don't know all about feed water heaters, send for the new catalog No. 51 describing



NATIONAL

FEED WATER HEATERS

Hot feed water—if it can be had at no expense—is recognized everywhere as the way to reduce fuel bills and reduce the wear and tear on boilers by eliminating those violent strains caused by feeding a hot boiler with cold water.

The National Pipe Bending Co.

91 Lloyd Street, New Haven, Conn.

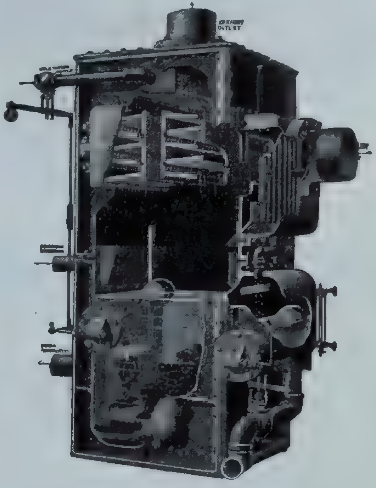
46-62

Is Your Closed Heater About Worn Out, Leaking Badly, Or Filled With Scale? What Temperature Do You Get?

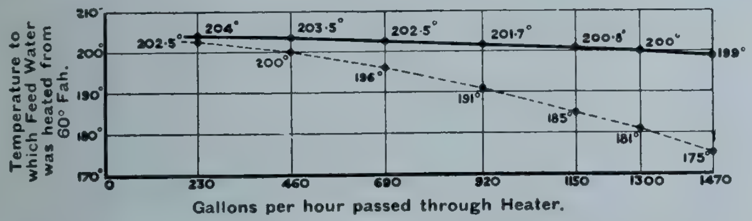
At best a closed heater rarely gives better than 180 or 190°F., when supplied with a surplus of steam at 212°F., besides it wastes the condensates. Then it is only a heater, that is, it does not purify the exhaust steam, does not purify the water or drive off corrosive gases dissolved therein, does not serve as an automatic raw water regulator, and cannot be used as a return tank or hot well, all of which functions, however, are performed by a

COCHRANE OPEN FEED WATER HEATER

Showing how scale accumulates in a closed or pressure heater and the evident difficulty of removing it.



Interior View of Cochrane Open Feed Water Heater and Receiver.



The above diagram shows graphically the results of Tests carried out with a new 1,300-gallon Closed Heater using exhaust Steam at atmospheric pressure.

At the rated capacity of the heater the temperature of the outflowing water was 200°, as shown by the full line, but in this case the water heated was only twice the weight of the exhaust used, so three times the theoretical amount of exhaust was required.

The dotted line shows a test with water 6.4 times the weight of exhaust used—near the theoretical amount. Note the temperature of 181°. A Cochrane would give 210°.

Therefore before ordering a new closed heater, or new tubes or other repair parts for your old one, look up the cost of the latest improved model of the Cochrane Open Feed Water Heater. The interest and depreciation on the difference in cost will be offset by the value of the 10 or 20°F. higher temperature of the feed water that the Cochrane Heater will give over the closed heater, remembering that each 10°F. represents 1% of fuel.

If you have a large quantity of exhaust steam to be purified of oil, before passing to the heating or drying system and if you need a receiver for the reception of the condensed returns, credit the Cochrane Heater also with the cost of the additional apparatus that would be required to supplement a closed heater, likewise for an automatic make-up water regulator, a steam trap to drain the separator, a feed-water skimmer, and the extra space and piping that would be required to connect the independent appliances.

CANADIAN ALLIS-CHALMERS, LIMITED

Manufacturers of Air Compressors, Avery Scales, Boilers, Cement-Making Machinery, Concrete Mixers, Flour Mill Machinery, Gas Engines, Hoisting Engines, Hydraulic Machinery, Lidgerwood Engines, Cables and Logging Machinery, Locomotives, Milling and Crushing Machinery, Ornamental Metal Work, Rock Crushers, Rock Drills, Saw Mill Machinery, Steam Pumps, Steam Specialties, Steam Shovels, Steam Turbines, Structural Steel Transmission Machinery, Turbine Pumps, Water Wheels, Water Pipes.

Head Office: TORONTO. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

G&K 1851
TRADE MARK

Educational Talks on Leather Belting.

What Constitutes Good Leather Belting

First—**LEATHER,** possessing in the highest degree possible the following characteristics:

Good driving surface, to enable the belt to operate under minimum tension.

Firmness, that the belt may remain straight, run true on the pulleys.

Pliability, that it may hug the pulley closely, securing a large arc of contact.

Little Stretch, that it will seldom need to be shortened. **Elasticity,** that it may easily take up and let go its load as it travels round the pulley.

Good tensile strength, that it may carry its load without breaking.

Resistance to external condition, such as heat, mosture, chemicals, etc., that it may do its work in any place, at any time, enduringly.

Second—**CEMENT** of the highest quality.

The **cement must be powerful,** elastic and immune to all the destructive forces that leather itself is able to withstand. As a matter of fact, the cement, when properly applied, becomes to all intents and purposes a part of the leather itself.

Third—**WORKMANSHIP and INSPECTION**

Careful and skillful workmanship should go into every process of construction. **Rigid inspection** of each operation is absolutely essential.

In short, high-grade leather belting can be obtained only from leather properly tanned, curried and finished; and that leather properly cemented with a suitable cement, all involving careful construction and rigid inspection of every process.

SUBJECT FOR NEXT MONTH:

Progress Made In The Manufacture Of Belting.

THE GRATON & KNIGHT MANUFACTURING CO.

Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory: Worcester, Mass., U.S.A.

D.K. McLaren's

GENUINE BRITISH-OAK TANNED
LEATHER BELTING

TRADE MARK

Every belt user should remember

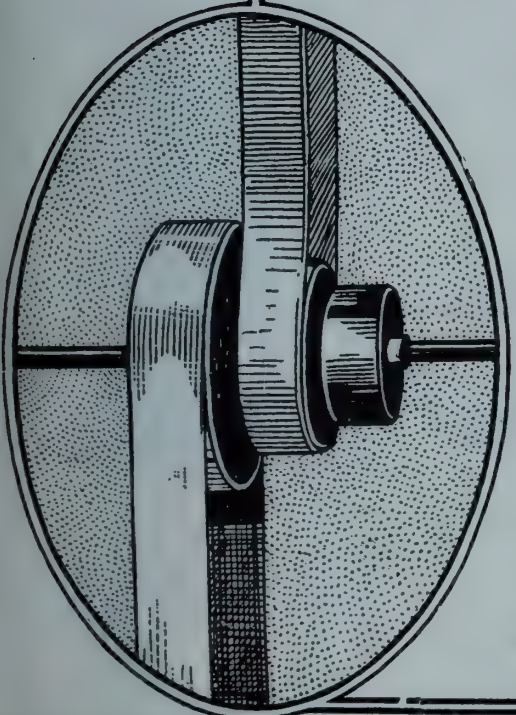
that there is no economy in buying a belt that is low in price. The cost of upkeep in such belts is enormous, and the power loss is surprising.

The real value of a belt lies in the service it renders.

The great care that our experts exercise in the selection of hides, our slow, old-fashioned British Oak method of tanning and our thorough stretching mean **that D.K. McLaren's Belting** is one of highest efficiency, and practical economy.

We want you to hear what users have to say.

Drop us a card for references.



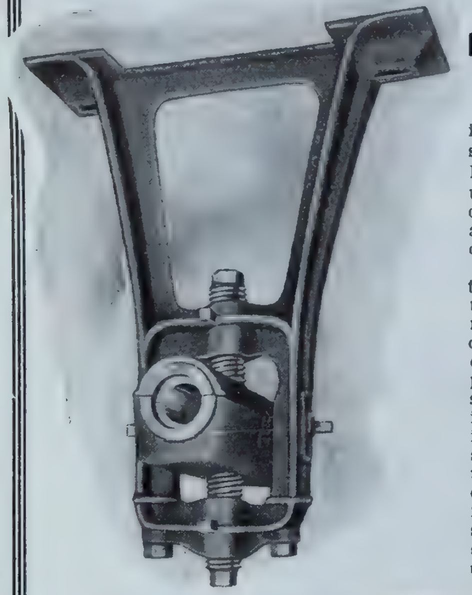
D. K. McLAREN Limited

Montreal	Toronto	Vancouver	St. John, N.B.
351 St. James St.	200 King St, W.		64 Prince William St.

ELMIRA

Ball & Socket HANGERS For MAXIMUM Service **Wood Split PULLEY**

AND BIG REDUCTION IN POWER TRANSMISSION COST



The "Elmira" Ball and Socket Hanger

is exceptionally strong and heavy. In this hanger a union system of oiling is employed, a combination of centrifugal and capillary attraction, effected by tempered steel rings and woven cotton distribution of lubricant, and precludes the slightest possibility of "Dry Bearings" so long as any oil remains in the reservoir or dry chamber, one filling of which should last from six to twelve months.

The "Elmira" Wood Split Pulley

You can use an "Elmira" Pulley any place that a leather belt will give satisfaction, and know that what any good pulley will do, it will do, and more.

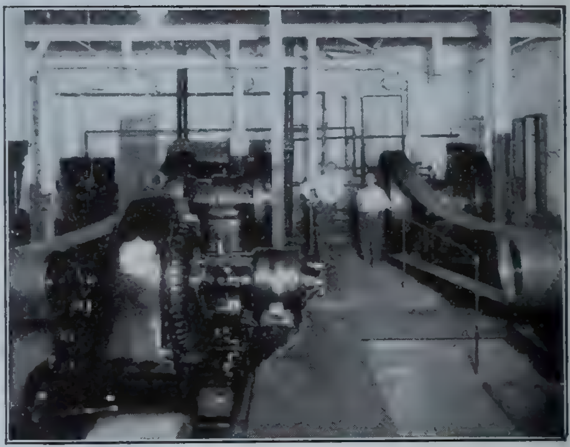
This pulley stands the hardest and most severe conditions. It is nailed throughout. The arms are tenoned into rim and dowelled there.

Absolutely guaranteed.

It will be much to your interest to let us furnish you with our illustrated catalog. Write for it to-day.

Large and complete stocks carried at Elmira and by The A. M. Ellicott Co., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Ltd.
ELMIRA, CANADA



Two belts in the plant of the Vincennes (Indiana) Electric Co., that have been treated with Cling-Surface for over a year. 14 in. belts; 3 ply leather; 125 h.p. engines; 270 r.p.m.; 115 kw. alternators. Belts run 14 in. slack.

Why Cling-Surface-Treated Belts Pull Best

Taken verbatim from Robert Thurston Kent's article "The Pulling Power of Slack Belts," from Industrial Engineering, May 1913 issue.

"The value of the treated belt apparently lies in the fact that the tension on the slack side of the belt so treated may, owing to the greater coefficient of friction, be decreased to a much lower value than for the belt not so treated, before slip occurs. This decrease in the value is accompanied by an increase in the length of the belt, thereby giving it a greater wrap or arc of contact on the pulley. These two factors both tend to increase the pulling power of the treated belt over that of the untreated belt in an increasing ratio."

Cling-Surface and the direct and indirect economy improvements are now receiving more serious attention than ever from prominent scientists.

The photograph of Cling-Surface-treated belts shown is but one of hundreds with accompanying data which we have to prove the lasting benefits.

Cling-Surface stops slipping, waterproofs, reduces friction, and permits belts and ropes to run easy or slack. Your belt or rope troubles would disappear from the first trial.

Tell us about your belts and ask for literature.

We quote f.o.b. Toronto

Cling-Surface the life preserver for belts

Cling-Surface Co
1057 Niagara Street
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I am interested in Cling-Surface and your trial order proposition.

Name ....
Position ....
City ....
State ....

76

THEODORE KIPP COMPANY

ENGINEERS

DEALERS IN MACHINERY

- Tubular and Water Tube Boilers
- Concrete Chimneys and Induced Draft Systems
- Chain Grate Stokers
- Coal and Ash-handling Equipment
- Heaters and Power Plant Specialties
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- Electric Apparatus of All Kinds
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- Flour and Cereal Mill Machinery
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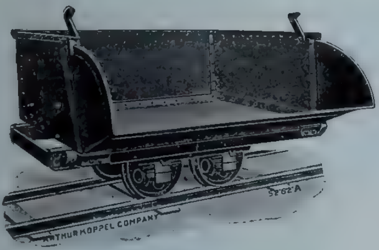
- Grain Cleaning Machinery
- Automatic Packing and Package Making Plants
- Special Apparatus and
- Recording Instruments for All Purposes

Write us regarding your requirements.

Union Trust Building, - - Winnipeg, Man.



A VERY satisfactory type of car for use in hauling ashes, dirt, etc., is the Scoop Car, which can be dumped either between the rails or to either side. Standard capacities are 12, 18 or 27 cubic feet for gauges of 18 or 24 inches.

How to Charge Furnaces Economically

A very important factor in the problem of keeping a constant supply of power is that of how to stoke furnaces efficiently. We are selling agents for a system of conveying coal and for charging furnaces in boiler rooms which requires very little labor and is practically indestructible. This system consists of the well known Koppel Cast Plate Track and Charging Cars.

ORENSTEIN-ARTHUR KOPPEL

Coal Charging Cars for the conveying of coal to boiler rooms are made of steel and are very durable. They are light in weight and easy and convenient to operate, being designed with special reference to boiler room service. The height of the cars is such as to make shoveling very convenient for the stoker. They may be supplied either with two side doors or end doors, as desired, and with or without swiveling base.

The rails of the track used in our boiler room systems are cast integrally with solid sectional plates, which provide a level surface to walk upon while car is being propelled.

We have a very interesting catalogue on this subject, showing many installations of the Koppel System, together with illustrations of cars, track, switches, turntables, etc., which we should like to send you. Ask for catalogue 412.

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DURABLA Etched on Every Glass

DURABLA

METALLIC GAUGE GLASS

Tough and elastic. Never breaks or clouds.
Ideal for steam, ammonia and hot oil.

Look for the trade-mark to be sure you secure the genuine DURABLA glass.

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Manufactured by
DURABLA MANUFACTURING CO. NEW YORK

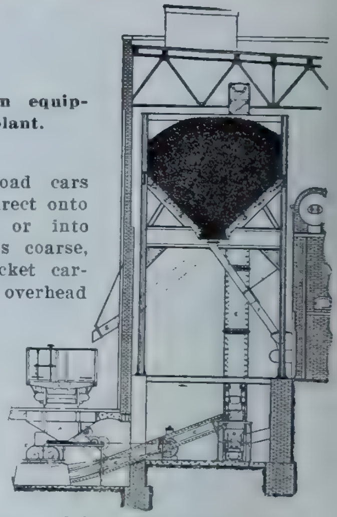
CLEAR

A Jeffrey System makes the handling of coal and ashes an easy problem to solve.

Look at this drawing of an equipment we installed at one plant.

Coal is dumped from railroad cars into hopper, and fed either direct onto an endless apron conveyer or into the crusher when the coal is coarse, and delivered to Pivoted Bucket carrier which elevates it to the overhead bunkers.

Ashes handled from under stokers to Ash Bin by the same conveyer.



We offer you free engineering advice, based upon forty years of experience in the manufacture of Elevating and Conveying Machinery.

Write for our new Bulletin No. 32B.

JEFFREY MANUFACTURING COMPANY

Canadian Main Office and Works, MONTREAL

"Maple Leaf" Brand

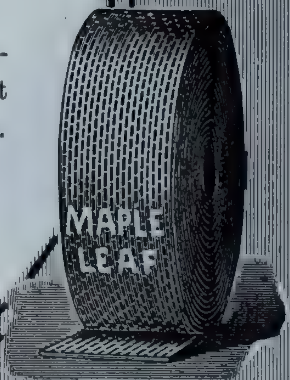
Stitched Cotton
Duck Belting

THE BEST FOR ALL KINDS OF BELTS

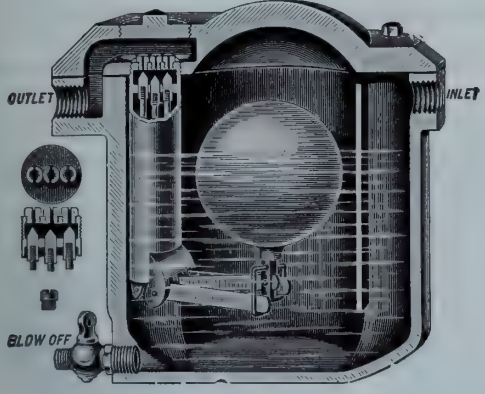
Means Reduced Upkeep Expense and Efficient Service

"MAPLE LEAF" is the strongest, truest running, and most economical belt on the market for Transmission of Power, Conveying, etc.

Ask us for further information and prices.



Dominion Belting Co., Ltd.,
HAMILTON, CANADA



Wright

"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited
15 Ottawa Street, MONTREAL
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KERR GATE VALVES

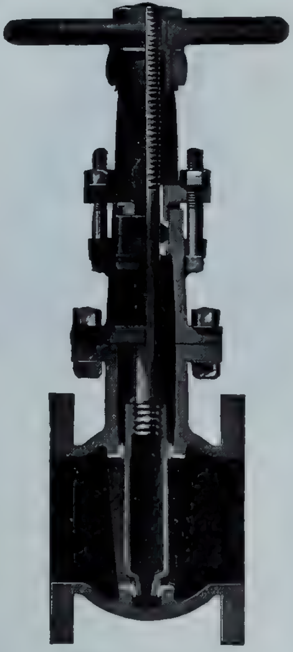
OUTSIDE SCREW AND YOKE
"KEYSTONE" PATTERN
Embody all the latest features

4½-in. and larger

- Screwed-in Seats
- Deep Bronze Bushed Gland and Stuffing Boxes.
- Full Opening.
- Large Diameter Hand-Wheels.
- Solid Wedge Discs.

4-in. and smaller

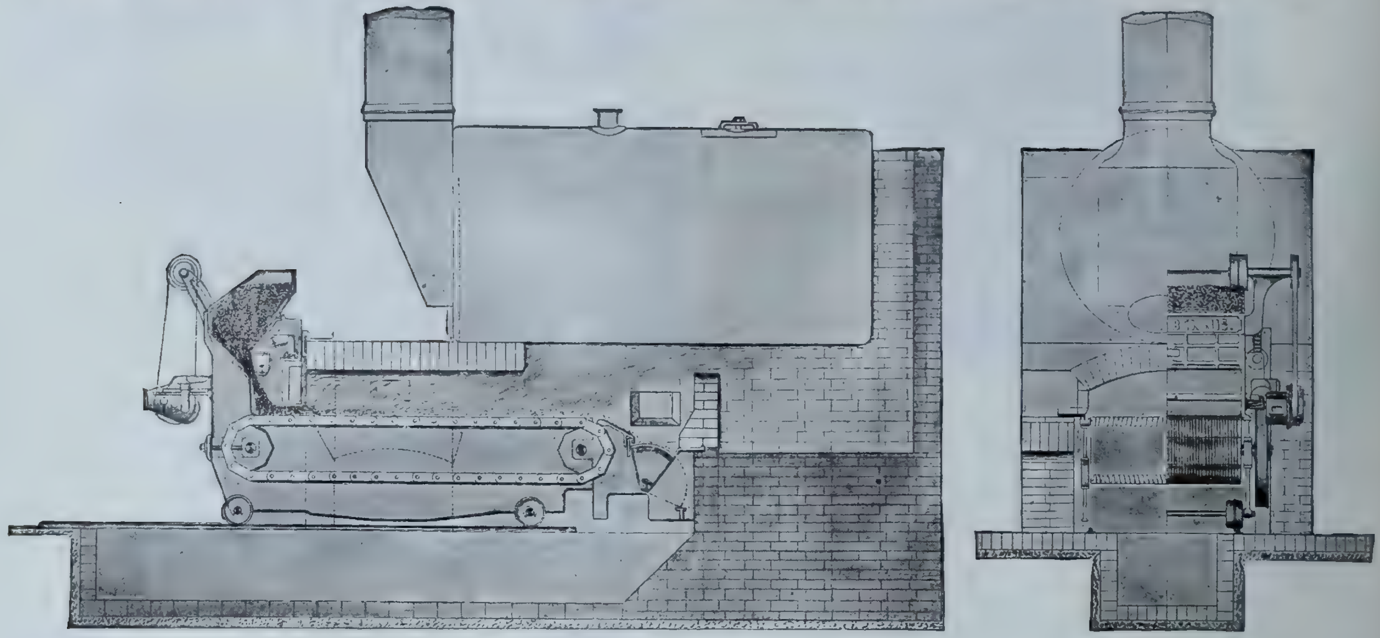
- Narrow face-to-face Dimensions
- Symmetrical Design.
- Good Material.
- Interchangeable Parts.
- Guaranteed Tested.



4½-in. and larger

The Kerr Engine Co., Limited, MANUFACTURERS
Walkerville, Ontario

The Chain Grate Machine-Stoker That Matters



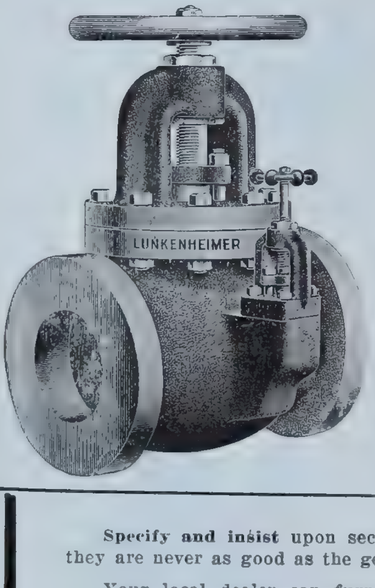
— BENNIS-PATENT CHAIN GRATE STOKER-APPLIED-TO-HORIZONTAL RETURN TUBE BOILER —

There is one machine-stoker for CHEAP steam-raising with water-tube boilers. It is the BENNIS Chain Grate, with the new Strong **Bennis** patent Long-Life-Link, which does not burn out, and keeps clear, strong fires with low-grade small fuels and slack.

Write for

"Machine Stokers That Pay" pamphlets to

G. H. TOD,
213 MANNING CHAMBERS
QUEEN STREET WEST
TORONTO
Winnipeg, 601 Union Bank Building



A MOST COMPLETE LINE

of high-grade Iron Body Valves, consisting of Globe, Angle and Cross; Horizontal, Angle and Swing Check; Gate, Blow-off, Pop Safety and Relief; Non-return Safety Boiler Stop, etc. Made in standard sizes and in a number of weights, the heaviest being for steam-working pressures up to 250 pounds per square inch.

LUNKENHEIMER IRON BODY VALVES

are exceptionally durable and strong. The iron used was furnished in the Lunkenheimer laboratories, and has a tensile strength of 25,000 pounds per square inch.

All parts subjected to wear are renewable and are made of a high-grade bronze composition, such as will safely withstand long and severe usage.

For hard service and superheated steam these valves can be had made of **"Puddled" Semi-Steel,** having a tensile strength of 35,000 pounds per square inch, or for extreme conditions of service, pressure and superheat they are made of **Cast Steel,** the tensile strength of which is about 80,000 pounds per square inch.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.

Your local dealer can furnish them; if not, write us.

A thorough description, with illustrations, is given in Lunkenheimer Catalogue No. 50. If you haven't a copy, write for one now.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World.

Executive Offices and Factories: CINCINNATI, OHIO, U.S.A.

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PIPE-THREADING

"100,000 nipples cut without one crooked thread"

THIS big, clean job turned out by a Chicago concern could be done only by an accurate, fast, ever-ready tool—they found it in the No. 300A model of Oster pipe-threading tools. The capacity of this machine for miscellaneous threading is unlimited. It will thread nipples—short bends—bolts—as readily as regular work. Interesting and complete information is contained in our "List 28." **Clip the coupon.**

OSTER TOOLS

The newest big-seller is the littlest OSTER

THIS die-stock, containing a surprising number of big features for so small a tool, has greatly simplified pipe-threading jobs of ¼-in., ⅜-in., ½-in. and ¾-in. Bulldog Die-Stock No. 81 is a fast-working, self-contained stock. No extra dies to carry, no loose parts to lose—important points when it comes to time-saving and convenience. Big, interesting features of No. 81 are described in the new pamphlet which we have had to publish on this new tool. **Clip the coupon.**

28 Cities in Canada have Oster Jobbers

The Oster Mfg Co.
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Kindly send me by return mail your complete catalog "List 28" and folder descriptive of No. 81.

Name ....

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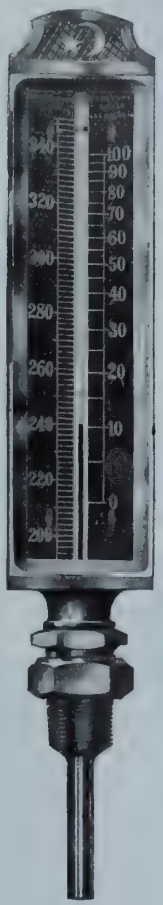
Accurate - Reliable

Always

THAT'S why "Crescent" Thermometers are used so extensively in Canadian Power Plants.

For consider — embodied in every "Crescent" Thermometer is the accumulated **knowledge** and **experience** of over 60 years of Thermometer-making. This is your **assurance** of the very highest degree of mechanical perfection. Best quality of material and extreme accuracy are a matter of course. And as for appearance — a more handsome instrument could not be desired.



"Crescent" Thermometers

are furnished in nearly 100 different styles and types. There is a complete line for all Power Plant requirements.

Our Catalog

WE have a complete catalog of instruments for Power Plants—interesting and instructive and well worth the having. A postcard request will bring it to you. Just say—"Send me Catalog W. 27."

The Schaeffer & Budenberg Mfg. Co.

BROOKLYN, N. Y.

Chicago **Pittsburgh**

The advertiser would like to know where you saw his advertisement—tell him.

THERE MUST BE A REASON—FOR REPEAT ORDERS

FOR

Murphy Automatic Smokeless Furnaces

West Virginia Pulp & Paper Co. - Piedmont, W. Va.

1st order, July, 1901	20 furnaces	6,500 H.P.
2nd order, July, 1904	2 "	600 H.P.
3rd order, Apr., 1905	2 "	600 H.P.
4th order, Apr., 1907	4 "	886 H.P.
5th order, Dec., 1913	8 "	2,400 H.P.
	36 furnaces	10,986 H.P.

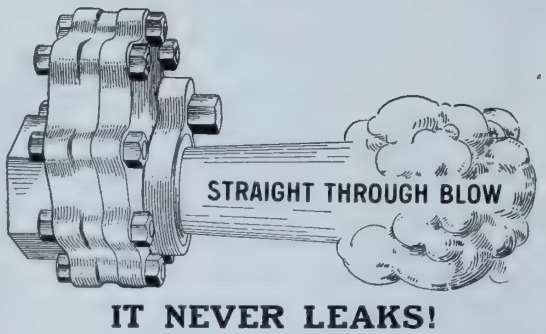
81 Paper and Coating Mills executed **188 contracts** for Murphy Furnaces—**86 repeat** orders—for **546 furnaces = 144,236 H.P.**

THE LOCKPORT PAPER CO., Lockport, N.Y., has been using Murphy Furnaces, 24 hours per day, 365 days per year, **FOR 29 YEARS.** "THERE MUST BE A REASON!"

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!

WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

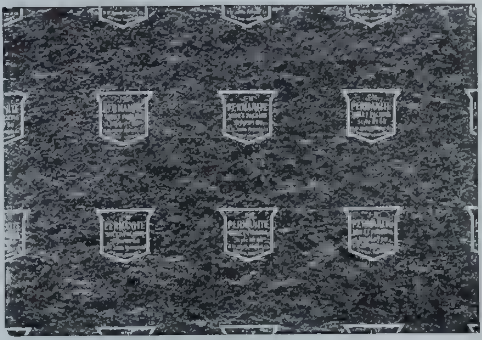
AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiler & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

J-M Permanite Sheet Packing

Must Make Good or We'll Stand the Cost



We want you, Mr. Engineer, to give J-M Permanite Sheet Packing a trial. We want you to test it on the most troublesome joints in your plant—joints that require your constant attention with other packings.

Our faith in what J-M Permanite will do for you prompts us to accept your order and let you try it entirely at our risk.

You can be the judge, and if J-M Permanite doesn't make good—if it fails to end the troubles these joints have been giving—if it fails to make them permanently leak-proof, then return what you have left and we'll refund the full amount of our bill. The trial won't cost you a cent.

Surely it's well worth your while to find out under the protection of our money-back offer, whether J-M Permanite Packing will put an end to those leaky joints and all the vexations and delays they cause.

Send your order to our nearest branch to-day with the above understanding, stating the conditions you have to overcome and size of packing desired.

You can't lose on this straightforward offer, for we take all the risk.

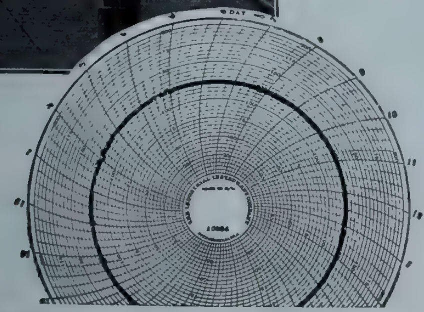
THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

MANUFACTURERS OF ASBESTOS PACKINGS; PIPE COVERINGS; HIGH TEMPERATURE CEMENTS; BOILER PRESERVATIVE; CONDUIT; METALLIC HOSE; FUSES; BOILER PLUGS; STACK LINING; TUBE CLEANERS; ETC.

Toronto Montreal TRADE ASBESTOS MARK Winnipeg Vancouver 2193

You can do it in Your Plant, too

You can get complete combustion and a smokeless stack—you can get a steady steam pressure, regardless of your loads—you can burn less coal, and cheaper coal—AFTER you instal a

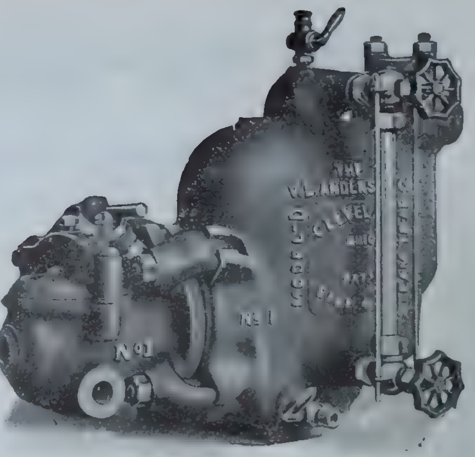


JONES UNDERFEED STOKER

What the Jones Stoker is doing in this plant at London, Ont., and what it is doing in hundreds of other plants, it will do in yours.

JONES UNDERFEED STOKER CO., LIMITED

NATIONAL TRUST BUILDING - TORONTO



Condensation is its "Open Sesame"

In the story of "Ali Baba," in the "Arabian Nights," we are told how the ponderously massive doors, that guarded the robbers' cave, while remaining unassailable to attack and impervious to the most skilled locksmiths, would swing open of themselves, at the mere repetition of the magic words "open sesame."

And like them, the

Anderson Model "D" Steam Trap

guarding the exit from your steam lines, remains immovable before the onslaught of the highest-pressure steam, yet opens instantly and is a ready means of egress for the condensation just as soon as it arrives.

To steam, the Anderson is a door, locked, bolted and barred—to condensation it is an open road, clear "as the hole through the pipe."

Ruggedly built, for the hardest service, it will stand up and perform its duties, year in, year out. Its quickly-changed valve and seat suit it for all pressures; its water gauge allows you to keep a tag on how it behaves; its interchangeable construction makes replacements easy.

Get the booklet of the Anderson. It gives in detail, its many special features.

The V. D. ANDERSON CO., 1935 West 95th St., Cleveland, Ohio

BRANCH OFFICES: 330 Manhattan Building, Chicago, Ill.; 6047 Jenkins Arcade, Pittsburg, Pa.; 3 Arch St., Philadelphia, Pa.; 212 Walnut St., Cincinnati, Ohio; 207 Union Trust Bldg., Baltimore, Md.; 91 High Street, Boston, Mass.

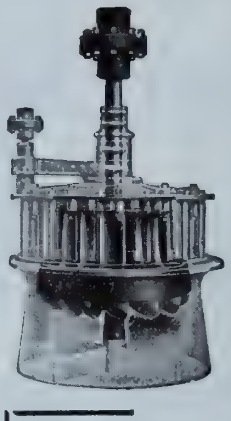
THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

This Company makes a specialty of Boiler inspection and reporting on their condition.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
John J. Durance, Manager.

Phone Main 6941



For All Water Power Purposes

If you have a water power you can use, the "Samson" wheel will develop that power most economically.

The high efficiency shown by this wheel in official tests proves its economy in the use of water, and shows what the wheel will do for you when working under your conditions.

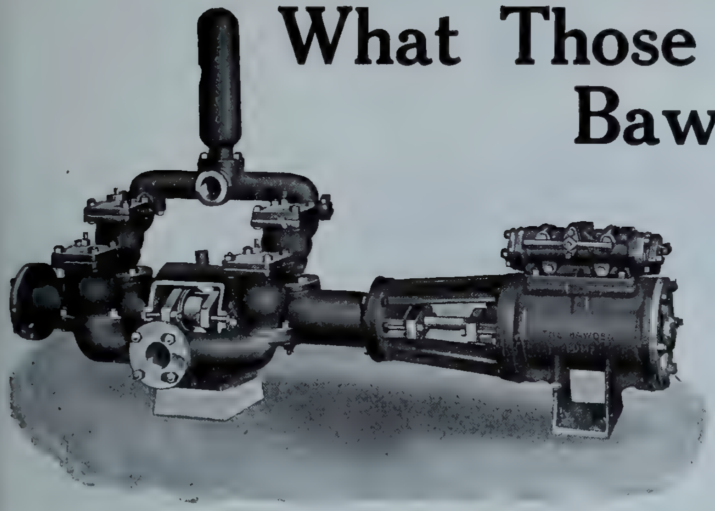
It is easily installed, and when in operation is easily controlled.

The "Samson" is always sold on an absolute guarantee.

Send for Pamphlet V.

William Hamilton Company
Peterborough, Ontario

What Those Who Know Say Of Bawden Pumps



A User:

"I would never know I had a pump, as it needs no attention."

An Engineer Who Has Specified Them on a Number of Large Jobs:

"It is the best pump I ever saw."

An Engineer Who Made Tests:

"I don't know another pump made that will stand those tests like that pump."

A Large Manufacturer:

"It is the best made pump I ever saw and a credit to Canada."

A Contractor Who Uses Them on All His Jobs:

"I put them in, they start right off, and I never have a complaint, so they must be good."

A Prospective Customer:

"I called up the users you gave me, and will take your pump."

Pumps for all purposes.
Write for Catalogue and Calendar.
And learn why Bawden Pumps cannot Short Stroke or Bang.

¶ The Bawden Pumps are operated by the Bawden Patent Balanced Steam Moved Piston Valves, which insures a Full Stroke of the piston under all conditions. **There are no** outside rods to stick or get out of adjustment.

¶ The water valves have no screwed seats, but are driven in on a special taper and are held solid by brass stoppers through the covers, all parts made on **jigs and faces** machined, so no sheet rubber packing is required.

Quebec Agents: H. L. Peiler & Co., 380 St. James St., Montreal

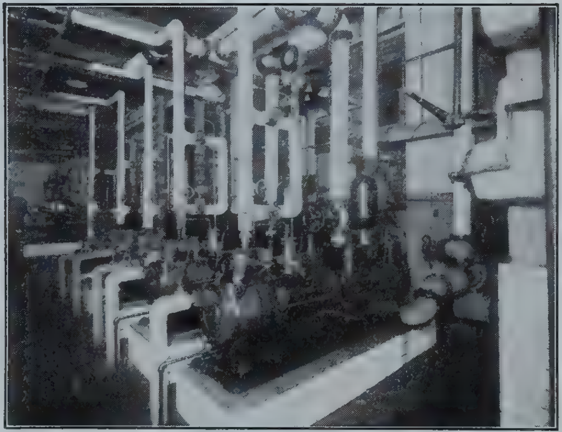
The Bawden Machine Co., Limited

125-137 Sterling Rd.,
TORONTO, CANADA

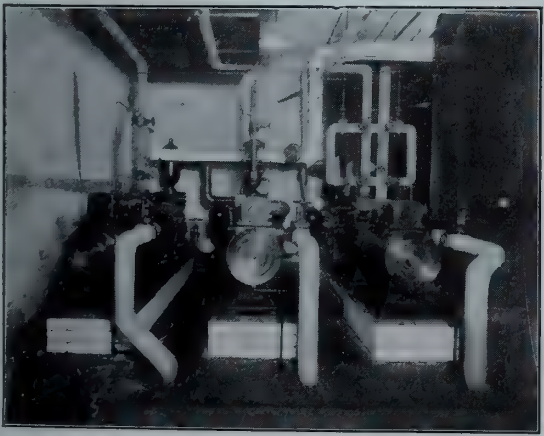
MARSH and AMERICAN
Pumping Machinery
For Every Service

Accompanying cuts illustrate an installation of Marsh and American Pumps made in the new C. B. & Q. office building in Chicago, Ill.

Marsh and American Pumps will also be found in many of the largest hotels and office buildings in the United States and Canada, including the McAlpin, Knickerbocker and Clarendon Hotels in New York City, the Brevoort and Blackstone Hotels in Chicago, the new Northwestern Terminal in Chicago, the new Michigan Central Terminal in Detroit, and the Simpson Department Store, Toronto.



Boiler Feed and Vacuum Pumps.



Elevator Pumps.

Marsh Pumps have been on the market for over 25 years, and continue to be the choice of discriminating engineers who desire the utmost in quality and reliability, regardless of first cost.

Our slogan: Simplex not Duplex. "To be simple is to be great."

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AMERICAN STEAM PUMP CO.

BATTLE CREEK, MICH.

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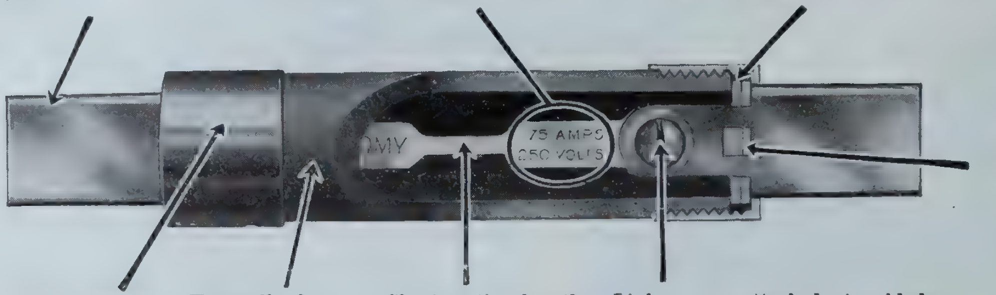
Gorman, Clancey & Grindley, Limited, Edmonton & Calgary.


Round edge hard drawn copper.
Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.
This venting feature allows no fire to escape, even on severe short circuits.
Washer assembly centres, locks in position and aligns blades.
75 AMPS 250 VOLTS
Heavy solid brass cap.
Unusually heavy gray horn fiber shell.
Short, active length of element assures uniform performance.
Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

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They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
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Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

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gives the light of three carbon lamps, costs much less than three, consumes no more current than one carbon, and does not deteriorate as quickly.

It will burn in any position, uses any current and is so durable that it has been adopted for service in fast trains, street cars and automobiles.

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Try a few. We guarantee satisfaction.

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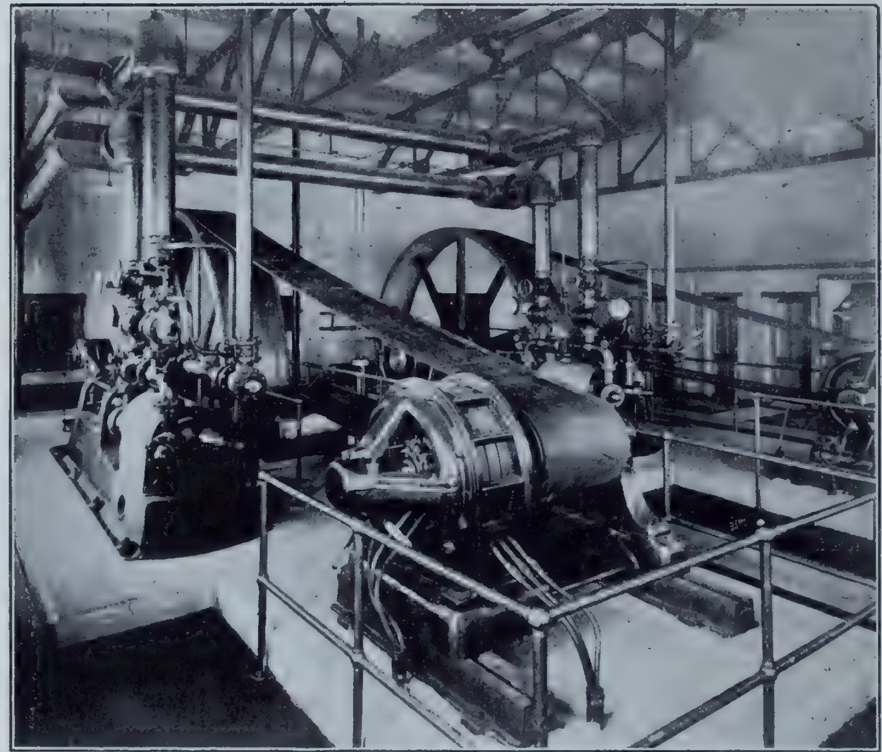
REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

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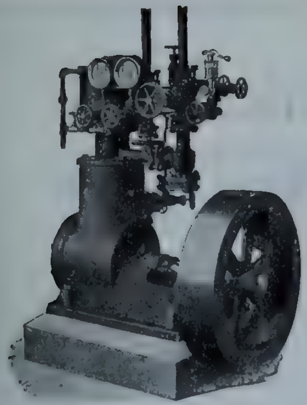

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Ice Making
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Built in any capacity that you desire.

Our small machines have the same "Regularity of Operation," "Reliability" and "Efficiency" as our large ones.

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Greatest Output in the World of Refrigerating Machinery

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Bare and Insulated Electric Wire

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There is no longer any doubt on this point. And then it is more sanitary, more economical, and more reliable.

But, as in any venture, success depends in a large measure on the selection of apparatus that will prove best for your requirements. You cannot make a mistake in selecting from our complete line of Compression and Absorption Apparatus. We are sure to have something that will fit your needs.

Plants from ½-ton Refrigerating Capacity and upwards.

Write us for information and prices.

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Largest Manufacturers of Ice-Making and Refrigerating Machinery in the World.

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The above machine is very desirable for those desiring only a small amount of refrigeration. Ask for prices.

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Refrigerating and Ice-Making Machinery and Equipment

We build all types of Machines. Get our Catalogue.

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A Refrigerator Door and Window

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1st. Efficiency
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products combine and recommend to the trained and untrained eye, unexaggerated ability to perform its work and to stand up to its place. The construction object is in defiance to the

Slam Bang Laborers "Disable Me If You Can"

HINGES AND FASTENERS weigh 60 lbs. to the set. The Doors and Windows work as easy as the front Door on your dwelling.

They will not leak.

Refrigerator Doors and Frame and Windows mean shipped complete ready to set in the opening.

We guarantee our "AD" statements.

We believe a big part of our success is due to pleasing our Patrons.

We are the sole manufacturers of the "NOEQUAL" DOOR with round jambs, so popular with the packing trade.

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Our Ice Doors and Chutes do all that is required.

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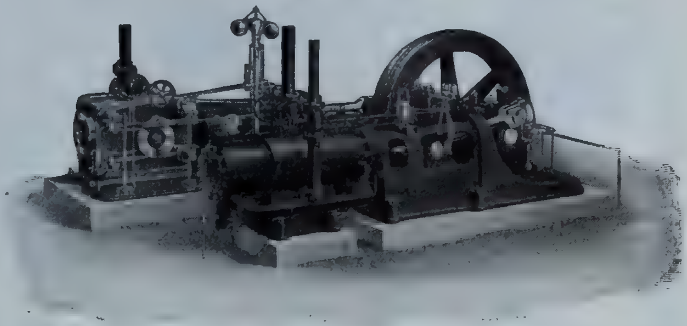
Arctic Ice Plants

In Canada



are bringing orders for similar outfits wherever installed. Why? For one thing, we guarantee:

20% more duty for a given size than any other horizontal ice machine built.

Then too, in workmanship, you simply can't beat an Arctic ice-making outfit. It's built that way—write us.

Bulletin I-C.

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You Can Stop That Loss At Once By Using Our

Corkboard Insulation

It is made of pure cork, and is recognized as the best insulation for cold storage and refrigerating purposes.

It is the only cork insulation that is made in Canada.

Write for full particulars.

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This 100-ton "Safety" installed at Fowler's Canadian Company, Hamilton, Ontario.

SUMMER ICE

Mr. Ice Machine User—Are you fully prepared for the coming summer months?

Has your plant been gone over thoroughly and made safe against every extraordinary demand?

You ought to go over your entire plant now.

Your requirements for new refrigerating and ice-making machinery can be met efficiently and economically with the "Safety."

"Safety" compressors are the best insurance against every shut-down you might otherwise experience.

Then remember that we have machines in stock which can be installed immediately and ready to operate before the summer ice season opens.

The Huetteman & Cramer Co.
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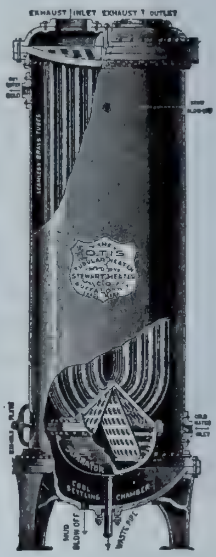
There Are Over 800 Otis Heaters in Buffalo Alone



Throughout the various states, thousands upon thousands of horse-power are in use.

Why this popularity?

Because Otis Heaters occupy a place in the engineering world that is second to none.

It is the only pressure heater made that contains an effective oil separator and cool settling chamber.

The exhaust is the heating agent, and 212° is the ordinary, not the spasmodic, temperature of the water.

The Otis has unusually large capacity and heating surface, and is tested under 200 lbs. hydrostatic pressure.

There's a "rock-ribbed" guarantee that covers every function and part of the Otis Heater.

Try it for 30 days at our expense. You have nothing to lose, and much to gain.

Catalog on request.

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DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name De La Vergne stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

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MONTREAL, Canada

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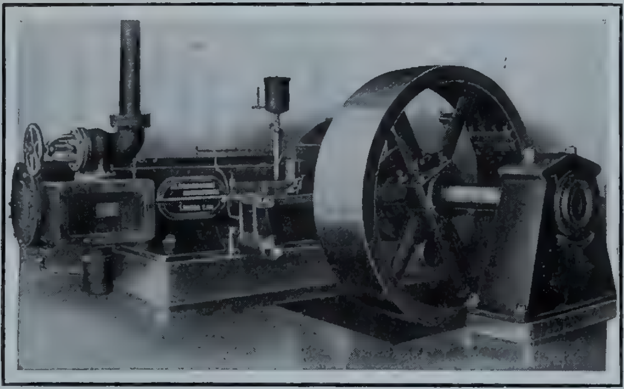

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Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

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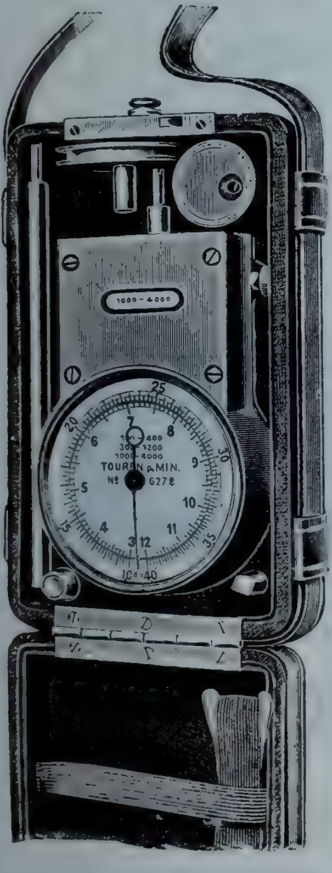

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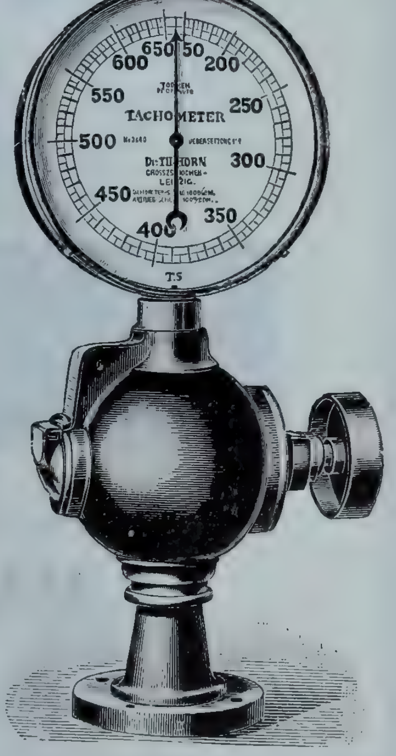

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Gentlemen:—Two years ago I had occasion to babbitt several bearings upon machines which ran upon reverse motion, carrying a heavy load. It is now two years since it was done, and at last accounts bearings still in A1 condition. When I insisted upon wanting MAGNOLIA METAL, was asked why I was so particular. I simply said time will tell. I had used it before and say to any Engineer who may have a troublesome bearing—"try MAGNOLIA METAL, and your troubles cease." To prove its worth I bought it myself, and found the proof was in the using.

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Steam, Gas, Hydraulic and Pneumatic Engineering

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The crank pin on one of a pair of twin engines driving a two-stage centrifugal pump persisted in running hot, and we tried plain brass and two kinds of babbitt without success. A liner of MAGNOLIA METAL was run in—that was about three years ago, and it is still running about 15 hours per day, giving no trouble whatever. It ran cool right from the start.

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QUEEN'S ENGINEERING WORKS, BEDFORD, England

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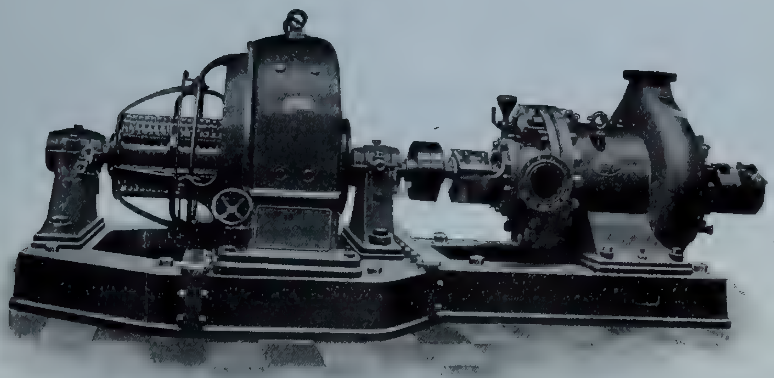
"CONQUEROR" PUMPING MACHINERY

Suitable for low heads and up to 1,800 feet.
Constant power, constant speed, with
varying head and quantity



"Conqueror" High-Lift Turbine Pump, driven by Continuous-Current Motor.
525 Gallons per minute, 1,450 ft. head.

For prices and full particulars, apply to the head office at

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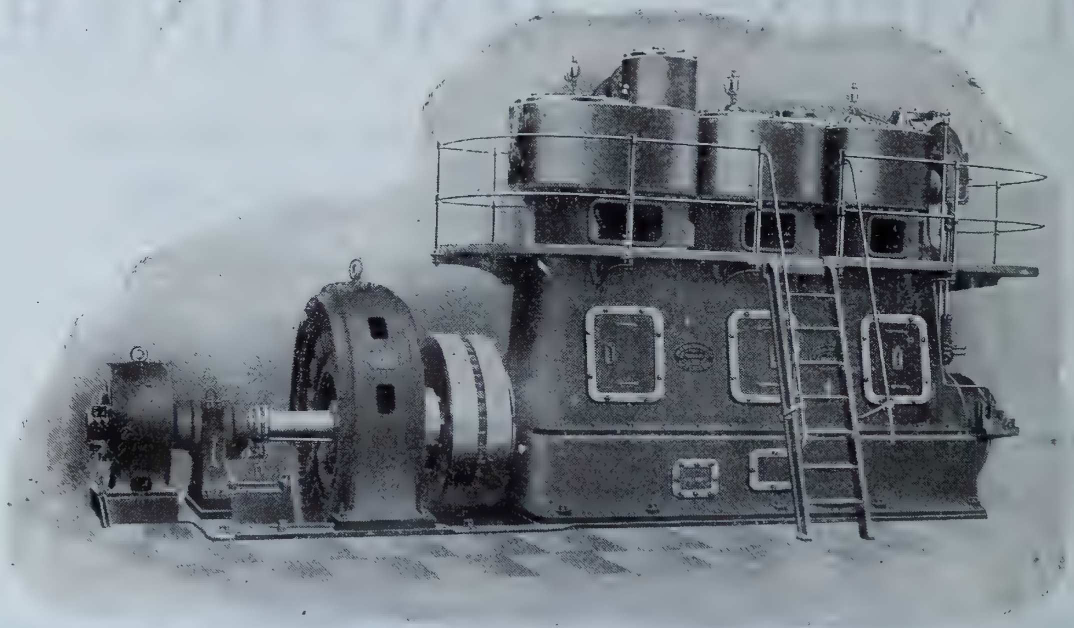
The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each;
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Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

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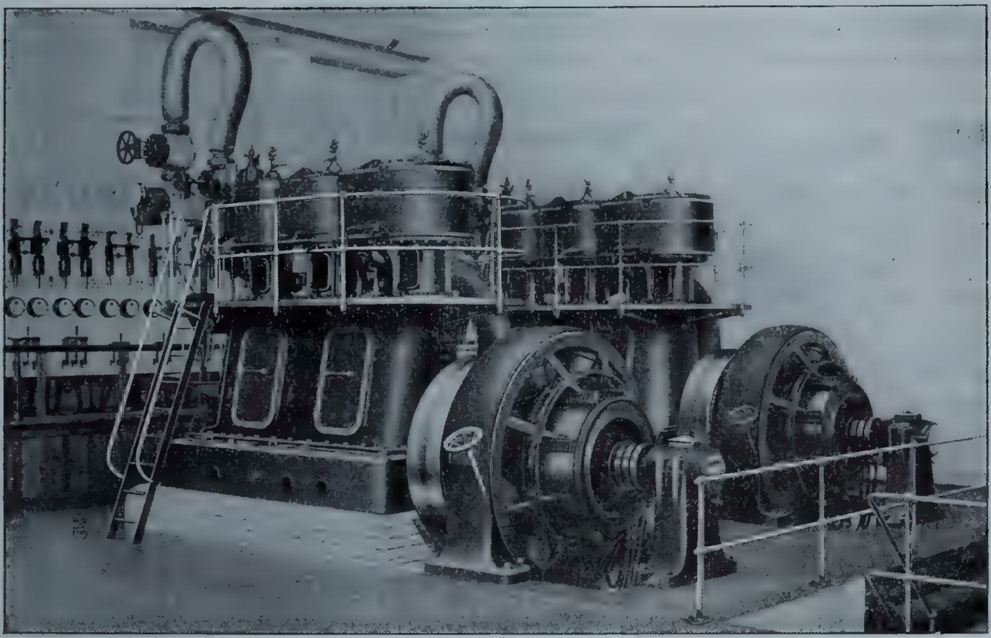

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We have installed upwards of 150 Belliss Engines in Canada.

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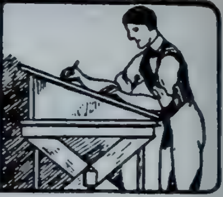

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¶ In the transformation of energy, do you stop to realize where your energy comes from?—Where the base of your power really is?—Where the big cost is?

THE COAL PILE

¶ Use every means to prevent waste in your power plant, but—

GET THAT COAL PILE RIGHT

Apply scientific methods of buying:

FIRST:—Select the proper coal.

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YOU MAY burn your coal efficiently; evaporate your water efficiently; convert your steam efficiently—BUT

REMEMBER THE COAL PILE

¶ Your economic methods for increasing efficiency should start at the real beginning of the expense.

Let us point the way to increased efficiencies all along the line! Our service includes:—

(1) Coal testing.
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THE TORONTO TESTING LABORATORY,
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IMPORTANT:—

We advise the proper treatment for your feed water, according to the analysis of your water supply.

THE SCIENTIFIC WAY.

We do not sell Boiler Compounds.

GET
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SERVICE
INTO
YOUR
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IMPORTANT:—

We conduct complete Boiler Trials, including furnace testing, coal testing, flue gas analysis, etc. IF YOUR CHIMNEY EMITS SMOKE, CONSULT US.

The advertiser would like to know where you saw his advertisement—tell him.

G. & McC. VERTICAL QUICK REVOLUTION STEAM ENGINES

Will give you as they are giving others wherever installed

A MAXIMUM OF SERVICE

At a Minimum Cost of Upkeep

These Engines have a Perfect System of forced Lubrication.

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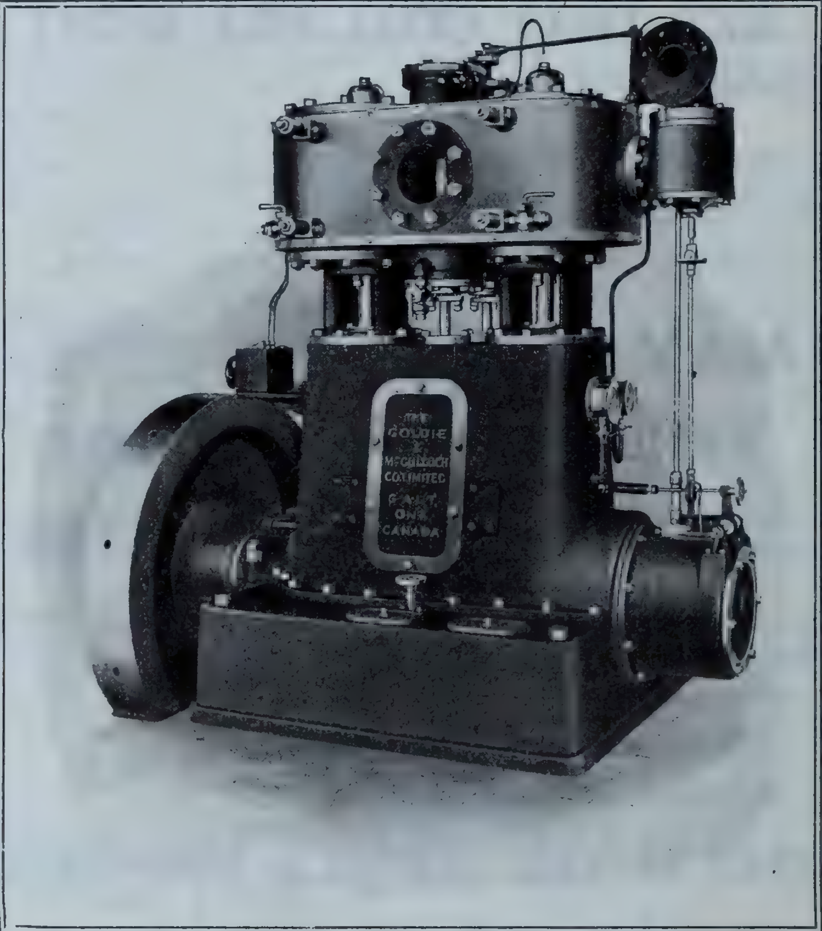

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Power, Light, Heat Features at Central Y.M.C.A., Toronto

Staff Article

Like public institutions generally, the Young Men's Christian Association of Toronto, have endeavored as far as possible to place their new building in the all-comprehensive unit class, and in none of the many excellent features to be noted in the general layout, equipment and furnishing is this more apparent than in that of the particular section to which this article pertains.

APPROPRIATE ceremonies marked the opening of the new central building for the Y.M.C.A., Toronto, on October 26th, 1913. The new building, together with the various branches throughout the city, provides exceptional facilities for the carrying on of the work which is associated with that institution. It has a frontage of 186 ft. on College street, a depth of 202 ft., and is of brick construction, four storeys high, with basement and sub-basement, while in the centre is a light court 70 by 50 ft. The architects, Burke, Horwood & White, Toronto, have designed a building on modern lines, and, at the same time, typical of this class of institution. The equipment generally is in accordance with the latest ideas.

COLLEGE STREET FACE, CENTRAL Y M.C.A., TORONTO.

On the third and fourth floors are the bedrooms and an emergency hospital. The classrooms and auditorium are on the second floor, while the offices, reading rooms, main and auxiliary gymnasiums are on the main floor. In the basement are located the bowling alley, billiard room, lockers, and cafeteria. One part of the sub-basement houses the swimming pool, while the power plant and general auxiliary equipment is in the other. The latter, again, is subdivided for boilers, engines and generators, filters, pumps, and ventilating plant respectively. The power plant is a complete unit, and represents a good example of an independent installation. The equipment is of the highest class, and of sufficient capacity to more than take care of present requirements, while the layout is such as to enable the best results to be obtained.

Boiler Room.

The boiler room equipment consists of four horizontal return tubular boilers, each of 125 h.p., 66-inch diameter by 16 ft. long, and of a working pressure of 100 pounds. The boilers were supplied by the John Inglis Co., Toronto, and are equipped with "cyclone" shaking grates and auxiliary injectors. The damper in the uptake breeching is fitted with a "Spencer" damper regulator, which is controlled by a "Johnson" thermostat. The coal bins are under the sidewalk and in front of the boilers. A "Turnbull" freight elevator is installed for the lifting of ashes, etc., to the street level. The elevator is operated by hydraulic pressure from the city mains, and has a capacity of 2,000 pounds.

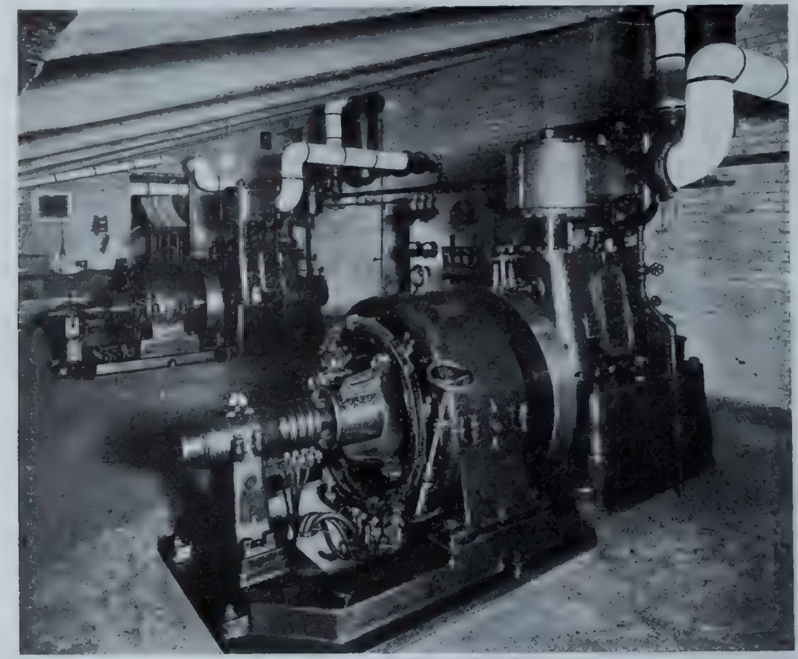
The boilers are blown off into a tank which drains into a sump, in which operates a "Deming" centrifugal pump having a capacity of 300 gallons per minute. This pump is direct-connected to a 2-h.p. "Swaby" motor. All the high pressure piping is extra heavy pattern, and includes "Crane" extra heavy fittings. The steam header is 9-inch diameter, with 5-inch diameter leads from each boiler. The exhaust pipe from the main engines to the heating system or atmosphere is 8-inch diameter. All the high pressure piping is covered with 85 per cent. magnesia, and the low pressure with asbestos "air cell" casings 1 inch thick.

BATTERY OF RETURN TUBULAR BOILERS.

Engines and Generators.

The generating equipment consists of

two high-speed, vertical, enclosed, engines, each direct connected to a Bruce-Peebles direct current generator, one set being 75 k.w. and the other 60 k.w., both running at 550 r.p.m. The generators are three-wire, 230/115 volts, and were installed by R. H. Nichols, Toronto.



ENGINES AND GENERATORS, CENTRAL Y.M.C.A.

The engines have each two cylinders of 10 in. diameter by 6 in. stroke, and were supplied and erected by the Goldie & McCulloch Co., Galt, Ont. The switchboard was supplied by R. H. Nichols, and has three grey marble panels—two generator and one distribution panel, each equipped with the usual recording instruments and switches. At the back of the switchboard are four balancing transformers. Cables are laid from the main switchboard to a distributing board located in an adjoining room. This board is of polished black slate, and was supplied by the Canadian Krantey Electric Manufacturing Co., Toronto. Current is distributed from this board to all the motor-driven equipment and also to the distributing panels, for lighting, on each floor.

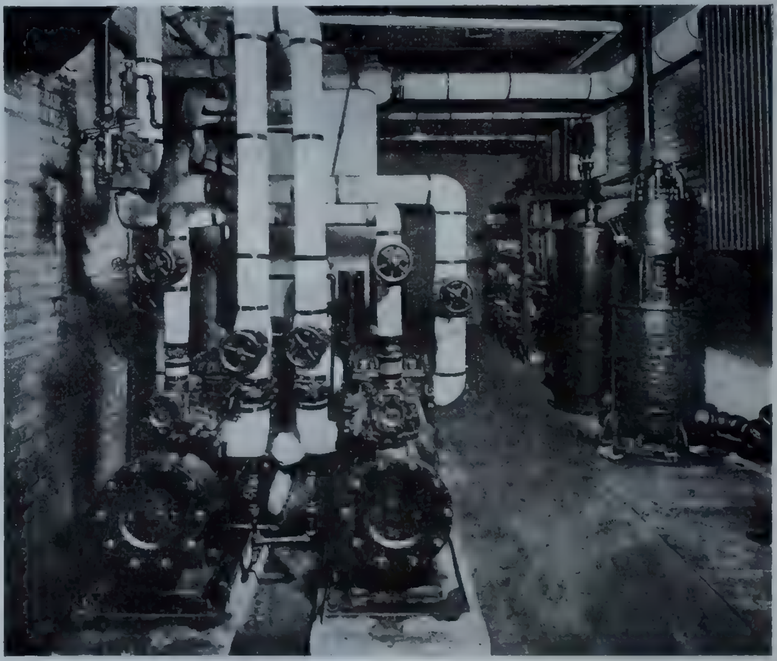
Pumps and Heater.

In the pump room adjoining the boiler-room are installed the boiler feed and vacuum pumps, "Webster" feed water heater, vacuum cleaner, and the distributing switchboard already referred to. A "Burnham" 9-14-12 vacuum pump delivers the returns from the heating system, etc., to an overhead receiver, from which they flow into the 500 h.p. open-type heater. The boiler feed is taken care of by two "Burnham" 10 7-12 pumps. These pumps and heaters were supplied by Darling Bros., Montreal, and the valves in the piping system by Jenkins Bros., Ltd., Montreal.

Heating and Ventilating.

The building is heated from the main floor up by means of radiators on the "Webster" system, and using exhaust steam from the engine. The steam line to the heating system is fitted with a "Darling" reducing valve which allows live steam to enter the line at a reduced pressure, in the event of the supply of exhaust steam being insufficient. In addition to the above, there is an indirect heating and ventilating system operating throughout the building. The fan and heaters are installed in the sub-basement, and have a capacity of 20,000 ft. of air per minute, the "Sheldon" fan being driven by a 7 h.p. C. G. E. motor. There are two sets of "vent" heaters, between which are fitted a screen for filtering the air. The heaters are automatically controlled by two "Johnson" duct thermostats, which are set at any desired temperature, and automatically close the diaphragm valves on the heaters when the temperature of the air rises one degree above the point at which the thermostats have been set. A directly opposite condition reopens the valves when the temperature falls one degree. The diaphragm valves regulate the steam passing to the heaters, and the thermostats control the valves by means of compressed air. The temperature control system was supplied by the Johnson Temperature Regulating Co. of Canada, with headquarters in Toronto. Compressed air is furnished by a motor-driven compressor.

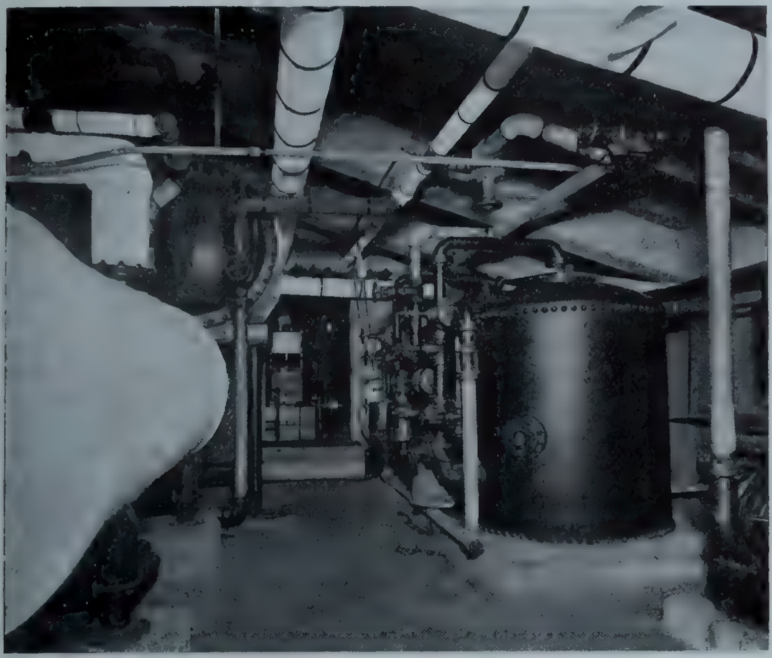
There are four "Sheldon" fans on the roof for drawing air out of the building, each fan operating its own section. The capacities are as follows:—One of 6,100 ft.; two of 7,300 ft.; and one 3,200 ft., and each fan is driven by a "Sprague" slow-speed motor equipped with regulating rheostats. In the air duct to the swimming pool is an auxiliary heater of 150 ft. capacity, which is additional to the main heating system.



PUMP ROOM, CENTRAL Y M C.A.

Filtration Plant.

The swimming pool is 75 ft. x 25 ft., and is 8 ft. 8 in. at the deepest end. The capacity is 80,000 gallons. The water is filtered daily, and for this purpose a filtration plant has been installed in the sub-basement adjoining the pool. It may here be remarked that it was considered better, both from an economical and hygienic standpoint, to clean the water daily rather than use city water direct, and only change the water as is the usual custom, about once a week. The filtration plant consists of two pressure mechanical filters, each having a capacity of 4,000 gallons per hour. The piping is so arranged that the filtered water can go direct to the pool or through the heater to the pool, or that city water may go direct to the pool. The filters are cleaned daily, by reversing the direction of the flow, previously cutting off connection with the pool, and allowing the city water to flow through the filters and out to a sewer connection.

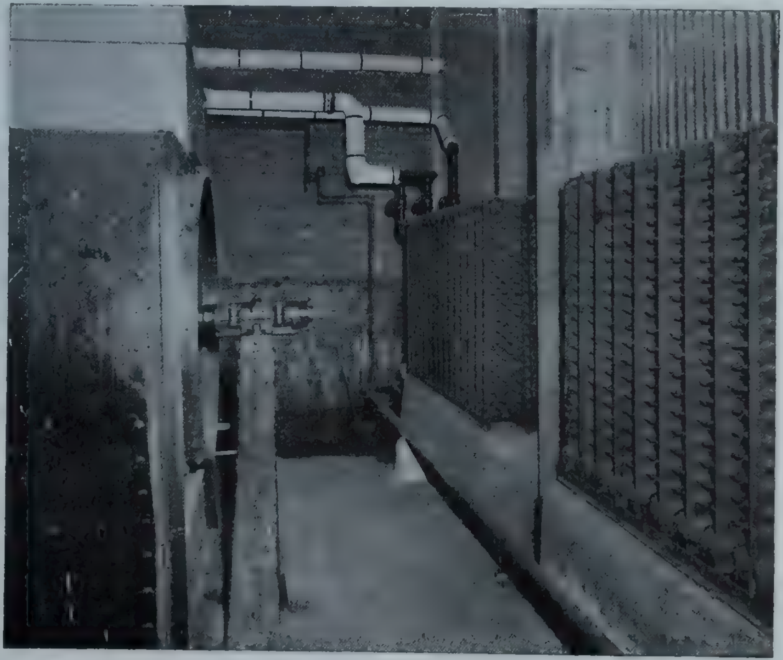


FILTER ROOM, CENTRAL Y.M.C.A.

When the water requires heating, it is passed through a "Sims" exhaust steam heater. This latter has a capacity of 9,000 gallons per hour, and heats the water to 80 degrees or about 75 degrees in the pool. It is fitted with a "Johnson" hydraulic thermostat control system which regulates the temperature of water delivered to the pool, so that it can be varied or maintained to suit requirements. In this case, the diaphragm valves are operated by city water at reduced pressure and under control of the thermostat. The drains from the heater are carried to the hot-well in the pump room. The water is pumped from the pool to the filter by a "Deming" centrifugal pump direct connected to a Bruce Peebles 5 h.p. motor. A Venturi water meter is installed in the pipe line between the pool and the filters, on the suction side of the pump. The pool is faced with white glazed tiles. There are 24 showers for adult members and 14 on the boys' side. The showers have marble trimmings and tile floors. Metallic lockers were furnished by the Hess Heating and Ventilating Co., Chicago.

Lighting.

The main floor and auditorium are illuminated by semi-indirect fixtures, each having three 60 watt tungsten lamps. In the classrooms and offices are semi-indirect fixtures each having one 60 watt lamp. The bedrooms are equipped with 25 watt lamps, and the corridors have 40 watt tungsten lamps fixed close to the ceiling and controlled from the main floor. The gymnasium is equipped with 150 watt lamps, three to each fixture, and under the gallery are 40 watt lamps in single units. The bowling alleys are illuminated by 100 watt lamps in groups of six, and the billiard tables have 40 watt lamps, three to each fixture.



SUPPLY FAN ROOM, CENTRAL Y.M.C.A.

Water Services.

The cold water service is supplied from three tanks situated on the roof and connected to the city mains. The hot water service for the showers, lavatories, and kitchens, etc., is supplied from a "Sims" instantaneous heater located in the sub-basement. The heater has a capacity of 10,000 gallons per hour, and was supplied by H. L. Peiler & Co., Montreal. It is heated by exhaust steam and is fed from the city mains. Above the heater is a storage tank which is equipped with a "Johnson" temperature control system, consisting of an hydraulic thermostat which automatically closes the diaphragm valves in the steam line to the heater when the water has reached a pre-determined temperature. Similarly it opens the valve when necessary. The valve is operated by city water at a reduced pressure, and is under control of the thermostat. The condensed steam in the heater is returned to the feed water heater by the vacuum system. The steam table in the cafeteria kitchen is supplied with steam at 40 pounds pressure, and the return pipe is fitted with "Dunham" trap, as is also the return pipe from the drying room heater.

General Features.

In the pump room is installed a "Spencer" motor driven, vertical turbine vacuum cleaning machine capable of handling four sweepers operating at one time. The machine is connected to piping installed throughout the building, which has sweeper connections on each corridor and in the large rooms. The vacuum cleaner was supplied and installed by Bennet & Wright, Ltd.

On each floor is a "Recti" gong and brake box in connection with the fire alarm system. There are also five standpipes at various points, with connections on each floor. These are equipped with 1½ inch linen hose.

An electric elevator has been installed by the Turnbull Elevator Co., Toronto. It is driven by a 25-h.p. 220-volt motor, and operates from the basement to the top floor.

The layout of the power plant was designed by Williams & Co., consulting engineers, Toronto, who were also responsible for the layout of the general mechanical equipment. Contracts covering plumbing, heating and ventilating, piping and wiring, were carried out by Bennet & Wright, Ltd., Toronto.—Photographs, courtesy of "Construction."

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SUBMERGED FIRING.

IN the Zeitschrift fur Dampfkessel und Maschinenbetrieb, recently, Privy Councillor Jaeger gives an account of the Brunler system of submerged firing. He points out that hitherto the construction of steam boilers has been based on the heat produced by the processes of combustion being conducted to the fluid in the boiler through its walls. This system involves very considerable losses both of heat and material. The Brunler "Greek fire" method of submerged firing is at first sight startling, but Mr. Jaeger describes the Brunler boiler which has been used with great success by the Wesenfeld, Dicke & Co., chemical factory at Dahl, near Langerfeld. The boiler plant consists of a cast steel generator in which the flame burns under the surface of the liquid, and of a cast iron collector for the liquid, the steam, and the gaseous products of combustion. The fuel used is coal tar oil.

◆

HYDRAULIC LIFT TROUBLES.

IN hydraulic lifts, states the Vulcan, trouble often arises through water leaking from the ram glands and falling on to the ropes. Where this possibility exists, the ropes should be well protected with a coating of tallow and blacklead well mixed together, otherwise the water will find its way into the interior of the rope, and, by rusting the wires, rapidly weaken them. Several instances of this kind have come to the notice of the Vulcan Company through its inspectors.

The danger in such cases lies in the fact that there is often no external evidence to show that the ropes are unsafe. In one instance the two supporting ropes of a lift broke without warning near to their anchorage to the cylinder, causing the lift car to fall the full height of the lift well, wrecking the lift and killing the attendant. On examination of the broken ropes it was found that the internal wires had been damaged by the water to such an extent that they were quite brittle and without strength, but no broken wires were noticeable before the accident at the point of failure.

The best way to prevent such failures is to design the lift so that water cannot possibly fall on the ropes, or, if this be not feasible, to fit drip trays or other appliances to keep the water off the ropes if leakage should occur.

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PRODUCER GAS FROM WOOD.

IN a lecture on "Producer Gas from Wood," recently delivered before the Junior Institution of Engineers, Mr. G. E. Lygo said that gas plant makers had given serious attention to the subject of utilizing wood for use in gas producers. In these plants all kinds of wood, from sawdust to pieces 6-in. diameter, cotton seeds, cocoanut shells, fibre and dust, sugar cane, coffee husks, rice husks, spent tanning bark, rubber leaf waste, surface peat, etc., could, he pointed out, be utilized.

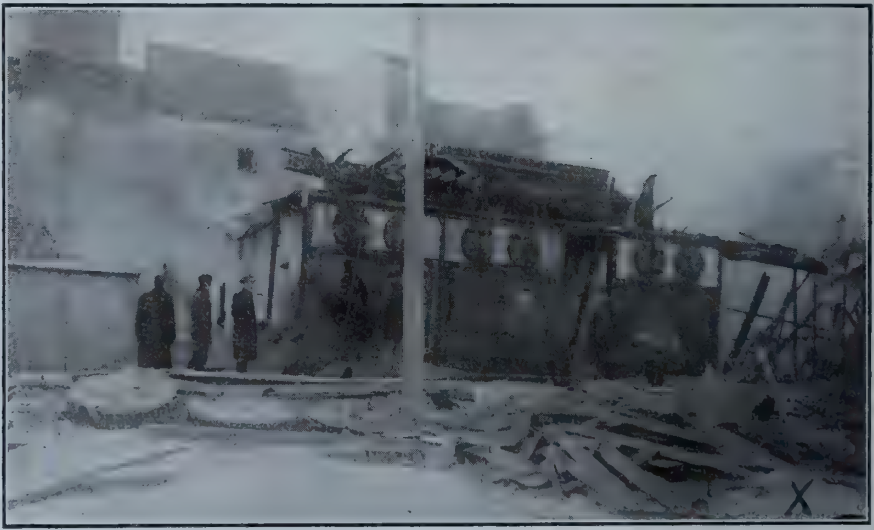
Referring to the design of the plant, the lecturer said many points had to be taken into consideration which were not needed with an anthracite plant. The area of the generator was governed by the nature and size of the fuel, but, roughly speaking, it was 2½ times that required for coal fuel. The depth of the fuel depended upon its size and density. A deep fuel bed was necessary for large pieces of wood, for otherwise air passed through and ignited the gas in the top of the generator

EXPLOSION WRECKS POWER PLANT BOILER HOUSE.

By J. H. Stoliker.

AN escape of natural gas and its subsequent ignition resulted in an explosion which practically destroyed the boiler room of the Chatham, Wallaceburg and Lake Erie Ry. Co. power house, at Chatham, Ont., on Tuesday morning, Feb. 24th. The picture tells a most vivid story of the force of the explosion. The north wall was blown out and the roof was carried clear off its supports. A number of men were in the building at the time, all of whom escaped except Wm. Roberts, assistant chief engineer, John Montague, fireman, and A. S. Davies, engineer in charge. These were all burned about the face and arms. Mr. Davies' injuries proved fatal, as he passed away early the following Friday morning. The leak from which the explosion resulted was caused by the breaking of a stop-cock which controlled the flow of gas through a 1½ inch pipe. The three Babcock & Wilcox boilers were not damaged to any extent and were put in service again the same day.

Mr. Davies had been in the employ of the Chatham Gas Co. for about 10 months, and was considered a careful and efficient engineer. His funeral took place Sunday, March 1, being conducted by the Masonic Order, of which he was a member. The members of the different departments of the Chatham Gas Co. who operated the power house, were present in force, as were also other members of the engineering fraternity. The other two injured men are getting along nicely, and hopes are expressed that they may have a speedy recovery. Mr. Davies was blown out of the building, and was picked up about forty feet away, the spot being indicated by a cross in the picture.



EXPLOSION EFFECTS CHATHAM, WALLACEBURG AND LAKE ERIE RAILWAY POWER HOUSE.

Breakdowns of Stationary Engines, Their Cause and Cure-I.

By Michael Longridge

The accompanying article, which formed the subject of a recent lecture before the Graduates' Association of the Institution of Mechanical Engineers, is one of special interest to power plant operatives. While this is so, the fact that faulty design and careless installation have played a large part in many "smash-ups," the advice relative thereto is such as to be of considerable value to those whose work lies in these particular spheres. The author of the paper is the well-known Chief Engineer of a large and leading English power plant equipment insurance company.

THE subject on which you wish me to discourse is "Breakdowns of Machinery," but that is a far larger field than I can well cover, so I propose to survey one part only—viz., that occupied by stationary steam-engines, such as are commonly used for driving mills and factories, and about these there is much more to be said than I can say in the short space of time allotted me.

Wreck From a Burst Flywheel.

Breakdowns of stationary engines is rather a sensational title for a lecture, and it is possible that some may expect a more exciting story than I am prepared to tell. That such may not be entirely unsatisfied, I will begin by referring to the bursting of the flywheel of a pair of horizontal compound engines, indicating about 400 indicated horsepower, and transmitting that power to a weaving-shed by a spur flywheel hung upon the crank-shaft. Both cylinders had Corliss valves. On the morning of the accident the engine started at 6 a.m. and ran as usual till about 7 a.m., when it began to race. The operatives threw off their looms and ran. The engineer and another man rushed to the engine-room, and with conspicuous bravery made for the stop-valve, which, as usual, was placed between the two cylinders, in a direct line with the flywheel. Before they could close the valve, possibly before they reached it, the flywheel burst and both were killed.

Some of the flying masses cut the traveling crane in two and unroofed the engine-room. Others cut through the wall of the engine-room and ploughed a path to destruction into the weaving-shed, unfortunately injuring four of the weavers who had been unable to escape. The flywheel arms were snapped off short, at their junctions with the boss, and a large piece was torn out of the boss itself, the pinion was broken, and the second-motion shaft—a heavy piece, 8½ inches in diameter—was dragged from its fixings and bent. The engine foundations were dislocated, and the engines themselves moved bodily from their places. Fortunately the cranks and connecting-rods remained connected, and the cylinders were saved, but all the valve-gear was smashed, and the bed-plate of the condensing engine was badly cracked.

Probable Cause of the Disaster.

When the wreckage had been cleared away sufficiently to allow access to the engines, I examined them. I found the governor, the wheels which drove it, and the knock-off gear in order. The front steam-valve of the high-pressure cylinder was open, and the spring in the front end of the dashpot, which should have closed it, was compressed, and cemented coil to coil, and to the walls of the dashpot, by a viscous brown cement consisting apparently of baked grease. The spring remained compressed when taken out. If it stuck fast when the engine was running, the steam-valve at the front end of the cylinder must have remained open, and the racing would be accounted for. In suggesting this as an explanation of the breakdown, however, I should mention that the consolidation of the grease about the dashpot spring may have been due to cold, for, owing to the destruction of the engine-room roof and wall, the engines had been exposed to very cold weather for several days before I saw them. The cause of the breakdown, therefore, is uncertain.

Classification of Breakdown Causes.

In another mishap of a similar nature the wreck was too complete to leave any clue to the cause. Fortunately, smashes so complete are the exception, not the rule. Of 71 breakdowns in 100 the cause can be discovered. The table herewith shows the number of breakdowns attributable to each of four groups of causes, as percentages of the total breakdowns during three consecutive periods of ten years.

Cause of Breakdown.	1881 to 1890. per ct.	1891 to 1900. per ct.	1901 to 1910. per ct.
1. Accidents and causes not ascertained	36	27	29
2. Negligence or ignorance of owner or attendants	19	22	19
3. Structural weakness, bad designing or workmanship	30	30	21
4. Old flaws, defects, or wear and tear	15	21	31
Total	100	100	100

An Improving Statistical Record.

The classification is not very satisfactory, because it is without clear lines of demarkation. It was begun many years ago, and could not afterwards be altered without much labor; but if the figures are not very accurate, their meaning is quite clear. Those in line 1 call for no remark, except that the high percentage in the first decennial period is principally due to want of opportunity for investigation. The constancy of the percentage in line 2 suggests that Board schools have not changed human nature over much; but the reduction in the last column of line 3 awakens hope that the vast sums spent on technical education have not been altogether wasted; and, if we take the figures for each of these ten years separately, hope changes to conviction, for we find the percentage falling more or less regularly from 23 in 1901 to 16 in 1910. If more evidence be wanted, it is given by line 4, which by comparison with lines 2 and 3 reveals how work and age are year by year supplanting ignorance, neglect, bad workmanship, and bad design as causes of breakdowns of steam-engines.

I do not mean to say that improvement in design only began ten years ago, but it was gradual. The substitution of the principles of mechanics and arithmetic for rule-of-thumb was slow, and the replacement of old engines by new was slower still, so that years elapsed before the effects of the change became appreciable; but if progress was slow, it was effective. When I began to collect statistics 34 years ago, engines running for the most part 50 to 60 hours per week broke down, on an average, once in 5½ years; now, though speeds and pressures have been doubled, they break down once in 9½ years. That is what we older men have done. Those who are taking our places are expected to do more; and if it will lighten your task to start it with some knowledge of the casualties from which the several parts of steam-engines most commonly suffer, I am here to tell you all I can in the time allotted to me.

Valves and Valve-Gear Failures.

I begin with valves and valve-gears, because at the present time they fail more frequently than other parts of steam-engines. About one-third of the total number of breakdowns originate in them. The proportion has nearly doubled in the last thirty-five years. It has increased concurrently with the use of Corliss and other complicated automatic trip-gears, made up of many pieces.

Many of those gears are too weak for the abnormal stresses to which all valve-gears are occasionally exposed; but a large proportion of the breakages is due to failures of the screws, bolts, and keys, by which the parts are held together.

Many breakages of valve-gears cause little damage, but some have very serious results. Most "runaways" are due to failure of valve-gears or governor-gears controlling them. Every engine, therefore, ought to have a "knock-off" gear acting on the stop-valve or a special runaway valve. Electric gears which can be operated by pressing a button in any part of the works, as well as by the knock-off motion on the engine, are the best. Valves intended to be closed by springs should be actuated by gears which will close them if the springs should fail, as seems to have happened in the breakdown I first mentioned.

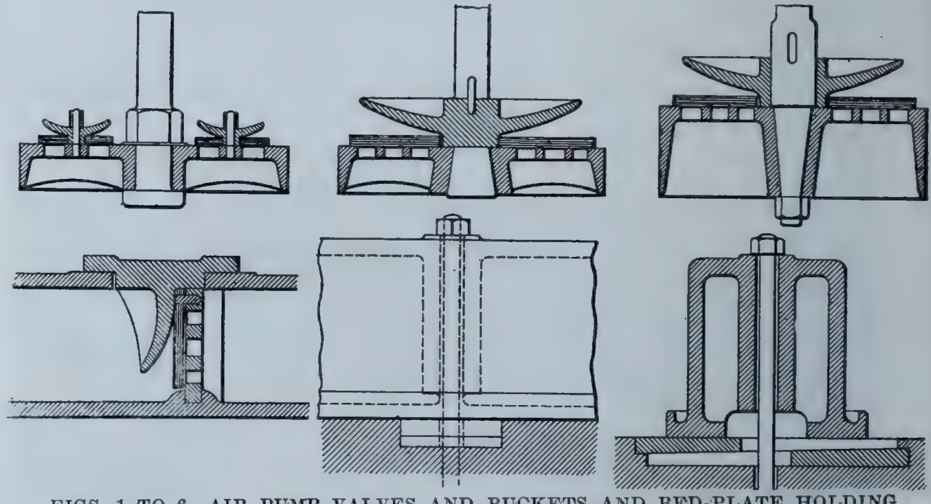
Not a few breakdowns are caused by eccentrics slipping or becoming disconnected from valves, leaving the one or other of the cylinder ports permanently open or closed. When this port is a steam-port of a high-pressure cylinder, a runaway may follow, and when it is an exhaust port, the compression curve may run up high enough to blow off the cylinder end. When the inlet to the low pressure cylinder remains closed, the pressure in the valve-chest or receiver may rise sufficiently to burst one or the other. All these things have happened, and the only preventives I can suggest are large safety-valves ferruled to prevent overloading, not only on the cylinder ends, but also on the receivers or pipes between the cylinders.

Air Pump Motions, Valves and Buckets.

Air pump motions, valves, and buckets are, after valve-gears, the parts which fail most frequently. They accounted for 20 per cent. of the engine breakdowns thirty years ago. They still account for about 16 per cent., and yet some trouble on the part of engine-tenders, and a little thought on the part of engine-builders, would enormously diminish the number of mishaps. The cause of half of them is corrosion and neglect, and the latter is almost pardonable when one considers the dark, dirty, inaccessible holes in which air-pumps are so often placed. Corrosion is to be expected, and should be circumvented by putting neither bolts, nuts, screws, rings, valves, nor guards inside the pump. There are both vertical and horizontal air-pumps on the market which can be made without a single fastening inside. If you must use the old-fashioned vertical pump, put no rings in the bucket; water-sealed buckets need not be tight. I have known two plain buckets ¾ in. less diameter than the pumps in which they worked to give 10 lb. vacuum in the cylinder.

Secure the bucket and guard against a collar or cone on the bottom of the rod by a nut or cotter on top, as in Figs. 1 and 2, instead of tapering the cone downwards and putting the nut below the bucket, as in Fig. 3, where it will drop off and allow the bucket to fall into the foot-box. Slide the foot-valve grid into grooves in the foot-box, and cast the guard upon the foot-box cover, as in Fig. 4, so that there may be no bolt to corrode and break. If the pump be horizontal, the bucket will not be water-sealed, and the piston must either be renewed when it has worn down, or fitted with a ring. The piston, being a plain disc, can be screwed and shrunk on to the rod.

Do not use combinations of brass and iron. If the water be at all acid, a brass-sheathed rod will be cut through, where the sheathing ends, as with a knife. Avoid trunk motions. The screw of the eye at the bottom of the trunk will suffer from corrosion, and the pin from grit. Every trunk motion I have had to deal with has broken down at least once. Finally, pay great attention to all fastenings; put the air-pump in a light, accessible place, and if there be any doubt about the free flow of the water from the hot-well by gravitation, make the motion fit for a pressure of at least 50 lbs. per sq. in. on the bucket.



FIGS. 1 TO 6. AIR PUMP VALVES AND BUCKETS AND BED-PLATE HOLDING DOWN FEATURES.

Bed Plates.

Breakages of engine-frames and bed-plates can be dismissed with a very few words, because by far the largest number are caused by the pounding of the engines or by wringing up holding-down bolts, after the seats below have been softened by oil. It is true that, with modern systems of lubrication, and oil recovery, very little oil should reach the seat, but it is equally true that the modern practice of wetting down an unplaned bed-plate in a rough lump of concrete, packing it level with any bits of iron that may be handy, and grouting it with cement, provides so little material to resist the oil that the grouting ceases to give adequate support even sooner than did the old ashlar seats with gallons of oil poured over them each week. The consequence is that breakages of frames, bed-plates, and the like still bear as large a proportion to the total breakdowns as in the early eighties—namely, about 7 per cent.

It is quite easy to keep engine-seats dry and free from oil. All frames and bed-plates should have channels round the feet, as in Fig. 6, and troughs under the ends of all bearings, or, when there is only a top and bottom brass, shields like those on the bearings for the shafts of dynamos and motors. The bed-plates of vertical engines of the marine type should have the bottom of the crank-pits cast with them.

Where a bed-plate is to rest on ashlar, it should be planed on the underside, and rubbed to a perfect fit upon the dressed surface of the stone. When it is to rest on concrete, the bottom surface which is to be supported by the cement grouting should be as wide as possible, instead of a strip a few inches wide along each side, and holes should be arranged at intervals for running the cement into the space between it and the concrete seat. In my opinion it is best to plane the underside at each holding-down bolt, and level the bed-plate upon a pair of broad machined folding-wedges at each bolt-hole, as in Figs. 5 and 6.

Cylinders should not be placed on concrete, but on iron frames or plating, according to their shape. This plating should have holes for running cement between it and the concrete seat, and there should be raised rims round these holes, round all openings for pipes and round the edges, to retain oil and water; also machined facings for the cylinder feet to stand on, so that they may slide when the cylinder end should be free to slide. Never tighten a holding-down bolt till the superincumbent weight has been lifted from the bed-plate, and the space below it, if there be any, carefully packed.

Cylinders.

In old days, breakages of cylinders were generally due to water or stray piston-bolts; now the majority are caused by water or structural weakness. The diagram, Fig. 7, shows plainly what has happened. The abscissae represent successive periods of five years from 1879 to 1913, and the ordinates the breakages of cylinders, as percentages of the total number of breakdowns, in each quinquennial period. The year 1883 may be considered as about the end of the old time, when 80 lbs. was a high pressure, and a tallow kettle simmered on the cylinder. About 1890 steam of 160 lbs. pressure began to be used in mills, and many old cylinders, reduced in diameter by liners, were supplied with it regardless of weakness of ends and valve-chests. Also, many of the new cylinders made about that time were too weak. The curve shows how breakages increased, and subsequently decreased as the new conditions were met by improved designs.

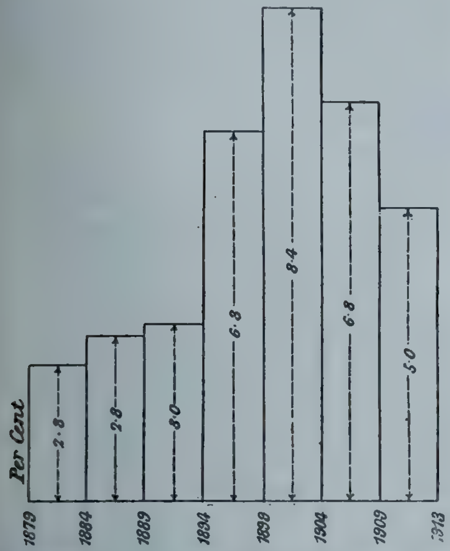


FIG. 7. CYLINDER BREAKDOWNS PER CENT. OF TOTAL BREAKDOWNS.

Before referring to some of the faults of design which provoke fracture, I would like to remind designers of cylinders and other parts that deformation, or strain, induces stress. It is often an advantage to consider what deformation would occur in the thing they may be designing if it were made of india-rubber. Figs. 8 and 9 show a cylinder made in 1894 for a pressure of 120 lbs. per sq. in. It worked for eight years at that pressure, then for 18 months at 140 lbs., and finally for six months at 160 lbs., when the two longitudinal cracks (A) (A), Figs. 8 and 9, were found.

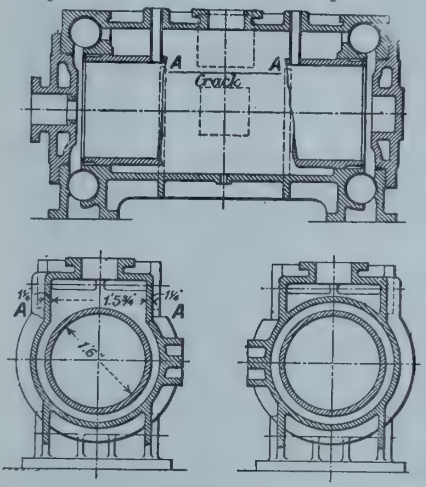
Regarding the cylinder as made of india-rubber, it would be seen at once that the two sides of the upper part of the jacket, Fig. 9, would be forced outwards, and bending would occur just where the cracks appeared. Even if the outer cylinder were complete, as in Fig. 10, the steam-passage would be a source of weakness, because its bottom surface, having the same pressure on both sides, would flatten out and allow the same kind of deformation as before. The flat top of the steam-passage, Fig. 9, was also weak, and would probably have cracked along its longest edges in course of time, for the stress calculated by the formula for flat surfaces—

$$t = p \times \frac{b^2}{2t^2} \times \frac{l^4}{l^4+b^4}$$

given in Unwin's "Machine Design" was 16,000 per sq. in.

In good designs, I have found (f) to lie between 3,000 lbs. and 8,000 lbs. The wide variation is not surprising when one considers how much the strength of castings is affected by shape and crystallization during cooling. In dealing with castings, experience is the only safe guide, though, for purposes of comparison, a formula may be useful as a rough criterion.

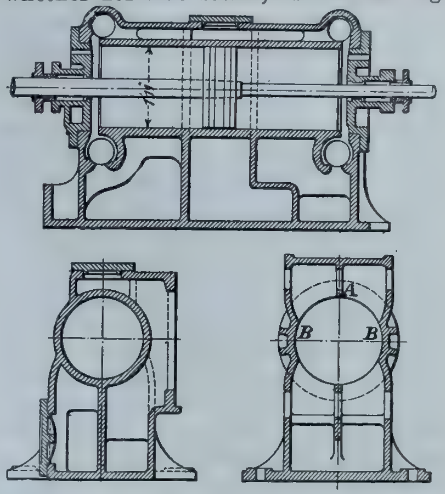
Figs. 11 to 13 show the high-pressure cylinder of a triple-expansion engine, made five or six years later, for a boiler pressure of 160 lbs., and a pressure of 70 lbs. in the receiver between it and the I.P. cylinder. Soon after it was set to work, it cracked through the bars across the ports (A) Fig. 13, and then from the corners (B) of the ports. It was replaced by another of the same design, which quickly failed in the same way. Here there was a load upon the end of 92 tons during admission and 52 tons during exhaust.



FIGS. 8, 9, 10. STEAM CYLINDER FEATURES.

If the cylinder had been rigid and the load distributed uniformly over the cross-section of the metal, the stress would nowhere have been excessive; but, with a cylinder of india-rubber, it is easy to see how a large part of the load would be concentrated on the bars across the ports, and how, on their failure, the deformation of the end would intensify the stresses at the corners of the ports. Also, deformation of the barrel from a circular to an oval cylinder would be caused by the external pressure on the top and bottom, and the absence of an equal external pressure on the sides. This deformation is sometimes sufficient to make well-fitting pistons seize.

Finally, passages cast round cylinders, whether for live steam, as in these figures, or for exhaust, frequently originate circumferential cracks in the barrel, owing to the unequal expansion of the metal inside and outside them. They are also likely to cause sponginess where the walls join on to the barrel. The design is not one to be copied, and I cannot but suspect that if the draughtsman had kept the india-rubber model in mind when he was drawing it, these cylinders would never have been cast.



FIGS. 11, 12, 13. STEAM CYLINDER FEATURES.

The usual way of strengthening the ends of cylinders is to lengthen the distance between the ports and the end flanges, and then to lengthen the spigots on the cylinder-covers to fill the increased clearance spaces. Unfortunately, the clearance surface at each end of the cylinder is thereby increased by two rings, each equal in area to the circumference of the cylinder multiplied by the length of the spigot—rather an important disadvantage when saturated steam is to be used, and guarantees of steam consumption are required.

Of course, it is possible to suppress the surface by making the spigots fit the cylinder, but then it is extremely difficult to get the cover off; or by making the joint at the surface of the spigot next the piston, but that may be as dangerous to the cylinder and cover flanges as a ring of jointing material placed entirely inside the bolt circle, unless special precautons, which I cannot now describe, be taken. The practical alternative seems to be to make the space so narrow that, when it is filled with water, the surface of the water presented to the steam in the cylinder will be so small that the condensation and evaporation will be negligible.

The late Mr. Bryan Donkin made some experiments for me to determine how narrow the space would have to be, and he told me that, under most conditions, differences of 1-16 in. in the diameter of cylinder and spigot would probaly suffice to keep the space filled with water and the surface inactive. His experiments were made with clean steam. With oily steam the space might possibly be increased, because the fluid filling it would be more viscous than pure water.

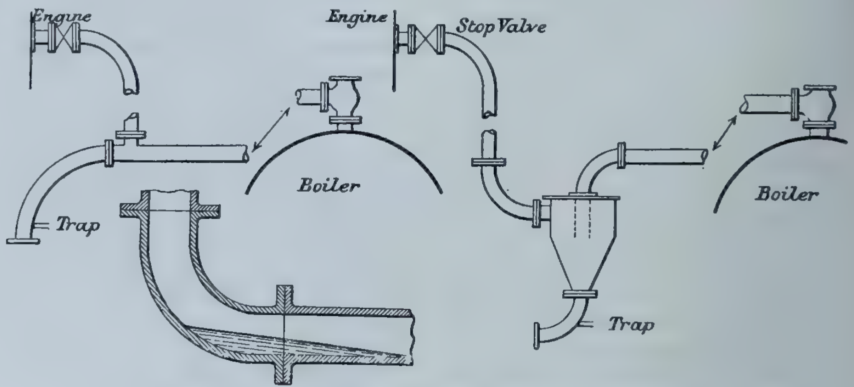
If the bell-mouth and spigot be bored and turned slightly conical and to fit each other when there is no jointing material between the flanges, then, when the jointing material is put in, the water space will be very narrow, but will widen rapidly as the cover is being drawn off. When the bell-mouth is very short, deformation, and local stress at the corners of the ports, may be reduced by bolting a deep cover, like a short cylinder with its two flanges tied together by ribs between the bolt holes, to the cylinder flanges.

The difficulty of designing cylinders for high pressures, and temperatures is much enhanced by attempting to combine valve-chest, steam and exhaust passages and cylinder in a single casting. It is far better to make cylinders plain tubes, or plain tubes with nozzles near the ends, and to carry the valves in suitable gable ends, with cylinder-covers or valve-chests bolted to the flanges on the barrels. The arrangement allows the barrel to be made of hard metal, giving an index number of about 40 when tested by Shore's scleroscope; while the more complicated castings, containing barrel, valve-chests, and passages, cannot be made with metal, giving a higher number than about 36. Moreover, the distortions produced by temperature and by the growth of grey cast-irons under temperatures as low as 500 deg. Fahr., imperatively demand the very simplest forms.

Damage by Water.

Leaving cylinder design, I now wish to say a few words about breakdowns from water. Water is seldom carried over from boilers in sufficient quantity to cause damage when steam-pipes are properly laid, as shown in Figs. 14 and 15, with a continuous fall from the boiler junction valve to a well-pipe or separator to the engine stop-valve, which should be at the highest point of the pipe, and as near to the cylinder as possible. Pipes with vertical bends, Fig. 16, are apt to harbor water when only a light breeze of steam is blowing through them, and this water is carried forward in gulps when the breeze becomes a hurricane. Even these gulps, however, seldom do damage, except when they get into the upper ends of vertical cylinders, the exhaust ports of which are shut before the end of the up stroke, or into horizontal cylinders with the exhaust-ports on the top.

Generally, the water causing breakdowns comes from jet-condensers, when an engine is running slowly, and the injection cock has not been shut, or the vacuum destroyed. The flow into a jet-condenser depends upon the vacuum therein, the flow out of it upon the speed of the air-pump; and it may easily happen, when an air-pump is running slowly, that more water may enter the condenser than the air-pump can discharge, in which case the excess first fills the exhaust-pipe and then runs into the cylinder. For this reason, when the air-pump is driven by the main engine, the vacuum should always be destroyed by letting air into the condenser before beginning to shut off steam; and when it is driven by an independent engine, this engine should be started before, and stopped after, the main engine. It is often extremely interesting to discover how water has got into a cylinder, but time will not permit of going into this point now in further detail.



FIGS. 14, 15, 16. STEAM PIPE ARRANGEMENTS.

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SMOKEBOX CINDERS AS FUEL.

IN the Zeitschr. des Ver. Deutsch. Ingen, Mr. O. Nerger emphasizes the importance of utilizing locomotive cinders for heating purposes, and describes the various plans put forward up to the present to do so. Experiments with chain grates and other mechanical methods of stoking have not been entirely successful. The management of the Royal Breslau Railway Co., which is building a new head workshop at Oels, has recently engaged in exhaustive researches on this subject. At the suggestion of Mr. Cohn, the Government engineer, these researches were extended to the forced draught traveling grate Pluto stoker, because it had already been found possible with this device to burn up profitably coke cinders, anthracite dust, and other non-gasing fuels of that nature.

Its chief element consists of a hollow grate piece which is movable to and fro, and is provided with slots on its inner or heated surface. Compressed air enters the furnace through these slots, pre-heating the air, and preventing any lowering of the general temperature of the furnace. In earlier trials, the cinders showed a tendency to cake together in spite of the motion of the hollow grate, and so their passage over the slots was impeded. The caking of the cinders also stopped up the slots and hindered the entrance of air. Thus the cinders were not completely consumed and a considerable proportion of unburned materials was found in the residues.

A number of slight modifications, such as regulating the speed and throw of the grates and the pressure of the air, remedied these defects, but the chief improvement consisted in introducing steam into the hollow grate bars as it loosened the clinkers and allowed the air to have free access to the furnace. The success of the arrangement is due to the continual loosening of the fuel by the to-and-fro motion of the bars, thus giving the air of combustion access to all parts of the fuel.

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Valve Setting Data Wanted.—R. W., Ottawa, Ont., wishes some information relative to "Valve Setting," also some pointers covering procedure to be adopted in cases of emergency due to valve trouble.

If our correspondent would be a little more definite in his query and let subscribers to The Power House know the particular type of engine he is operating; the construction of its valve feature, whether slide piston or Corliss valve fitted, etc., there will be, we are sure, no lack of helpful instructive replies forthcoming from the pens of our readers.—Editor.

Power Plant Equipment, Rolph & Clark Ltd., Toronto, Ont.

Staff Article

In all lines of manufacturing there is in evidence a desire when plant extensions or additions have to be undertaken to so lay out and equip the various departments, that not only will a higher degree product be the outcome, but a healthy, wholesome and comfortable condition of operating will be the lot of the employees. With this ideal in view, power, light, heat and ventilating provisions are indispensable. The accompanying article features these in the plant under review.

ROLPH & CLARK LTD., Toronto, recently started operations at their new lithographing plant which is the largest establishment of its kind in Canada. The building is of fireproof construction and consists of brick walls, steel columns and steel roof trusses, with the main floor of concrete. The offices are situated on a gallery or mezzanine floor at the front end of the structure and overlook the main or factory floor.

All the machines are driven by electric motors, there being over sixty of these installed throughout the factory. Direct current is used for the motors and other equipment, and in order to convert the a.c. current from the Toronto hydro-electric lines to d.c., a motor-generator set has been installed. The motor generator set and switchboard are located in a room at the rear end of the building and on the main floor. This room is enclosed on two sides by glass screens with metal frames and on the other sides, the walls are faced with white glazed bricks. Artificial illumination is provided by a semi-indirect lighting fixture.

Electric Installation.

The motor-generator set consists of a 100 k.w. 110-125 volt, a.c., interpole generator, direct connected, on a common bed plate, to a 145 h.p. induction motor, 3 phase, 550 volts, 25 cycles, 450 r.p.m. The switchboard is of Blue Vermont marble and contains 4 panels equipped with the usual instruments and switches. There is one motor-generator panel, one d.c. generator panel and two feeder panels. At the back of the switchboard, and underneath it are two 20 k.w. lighting transformers, 550 volts primary and 110 volts secondary. These are for the lighting circuit when the motor-generator set is not required to be running, or in the event of an overload, in which case the current would be taken direct from the outside feeders and delivered at 110 volts to the lighting circuit. The motor-generator set, switchboard and transformers, were supplied by the Canadian Westinghouse Co., Hamilton, Ont., and were installed by the O'Connor Electric Co., Toronto, who also carried out the entire electrical installation.

Boiler Installation.

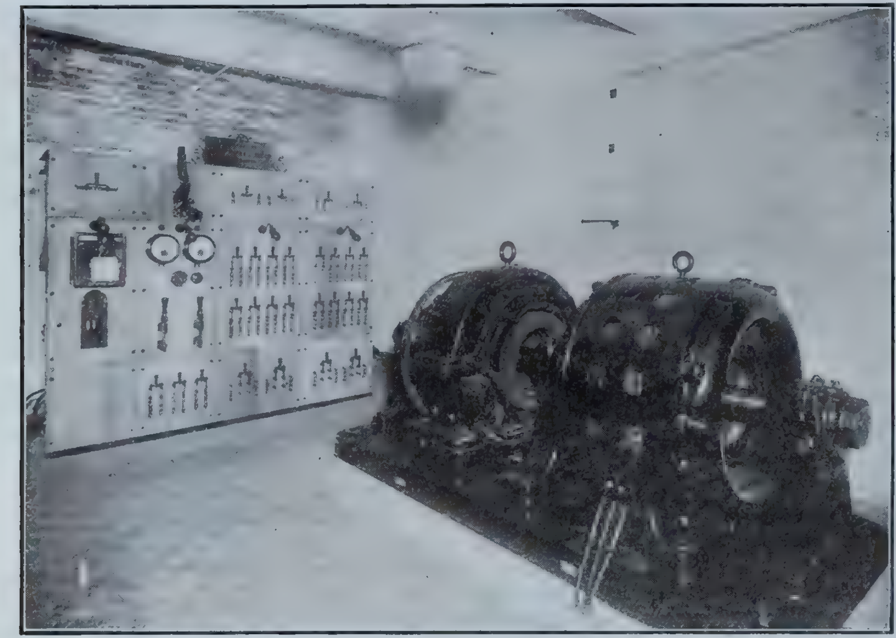
The boiler room is situated at the rear end of the building and at a lower level than the main floor. The pumps and heating and ventilating plant are located in the boiler room, the pumps being on the boiler room floor and the air washer and heater on a gallery above the pumps.

The boilers are two in number and are of the horizontal return tubular type, 78 in. by 18 ft., containing 1800 sq. ft. of heating surface and rated at 150 h.p. each. They are set in the standard suspension setting at centres 7 ft. 11 in. apart, and were built and installed by the Berg Machinery Mfg. Co., Ltd., Toronto.

Stoker Installation.

Two stokers have been installed under these boilers of the Fulton water-cooled type, manufactured by the Hare Engineering Co., Ltd., Toronto, and contain 36.7 sq. ft. of grate surface each. This gives a ratio of heating surface to grate surface of 49:1 which is sufficient to admit of heavy overloads being carried whenever required. These stokers are of the inclined front feed type, the coal being fed from a hopper which extends across the whole front of the stoker and from which it is fed down on the grates by the pushers. The grates are made up of broad flat cast iron plates extending across the width of the stoker and arranged in two separate banks, one of which is fixed to the frame of the machine, while the other is connected at the front end with a revolving eccentric which causes the grates in the moving bank to have an elliptical motion, and thus the coal is gradually pushed down over the inclined grates while being consumed. By the movement of the fuel thus secured, it is impossible for the coal to slide on the grates, thus air holes in the fire are prevented, while by the construction of the grate bars themselves, sifting of unburned coal through to the ashpit is avoided. The grate bars of this stoker are water protected by 1¼ in. extra strong seamless tubing being cast in each grate and connected to carry water circulation from the boiler. By the introduction of special check valves in this tubing, a flash system of circulation is set up which gives a high velocity of steam and water in the tubes and thus prevents accumulation of scale. It is claimed for this system that grate bar repairs are practically eliminated.

The stokers are operated by a 3 in. by 3 in. vertical engine running at 175 r.p.m. and back geared through enclosed cut spur gearing to the stoker drive shaft. The power required to drive the stokers is about one-third of one per cent of the steam generated, and in a recent test these two stokers were operated with only 7 lbs. of steam. Each stoker is driven from the common driving shaft by an independent ratchet and, in this way, can be driven at any desired rate of capacity independent of one another. This is found to be a decided advantage where a number of stokers are driven from a single engine. The successful operation of the plant was put to a severe test during the recent cold weather and although the thermometer registered 20 deg. F. below zero, no difficulty was experienced in carrying the load on one boiler and stoker, even though this represented a considerable increase over normal.


MOTOR GENERATOR SET AND SWITCHBOARD.

The draft is secured by a Heine radial brick chimney 119 ft. 6 in. high by 50 ins. inside diameter. It was built by the Heine Chimney Co., Chicago, Ill.

Pump Installation.

The boiler feed pump is of the horizontal duplex type, 4½—2¾—4 in., and is fitted with brass valves, seats and stems and brass linings to the cylinders. There are two vacuum pumps installed in connection with the heating system. These are of the horizontal single steam driven type, 6-8-12 in., and are fitted with Tobin bronze rods, brass lined glands and cylinder linings. A "Kiely" regulator is fitted in the return line from the heating system and the feed pump is equipped with a "Mueller" pump governor. All returns from the heating system go to a common header and are pumped to a receiver, then back to the boilers. The pumping installation was supplied by the Deane Steam Pump Co., Holyoke, Mass.

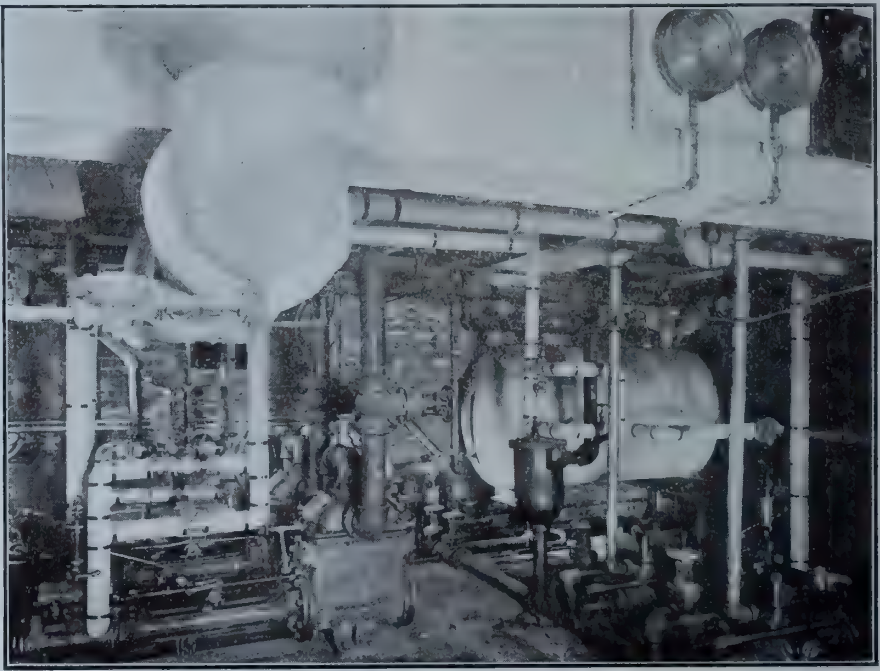
Heating and Ventilating System.

The building is heated by a low pressure steam system, but there is installed for ventilating purposes a heating and ventilating system in addition. This apparatus consists of a "Vents" tempering coil and a reheater containing a total heating surface of 2600 sq. ft. Between the heaters there is an "Acme" air washer consisting of a series of eliminators and spray heads which are flushed automatically and controlled by an automatic device connected to a centrifugal pump on the boiler room floor. The pump is driven by a 3 h.p.C.G.E. motor running at 1100 r.p.m. Under the spray heads is a tank which, when full, automatically drains into a sump where the pump just referred to is located.

In connection with the above, there is installed a Canadian Sirocco full-housed single inlet fan having a capacity of 40,000 cubic ft. per minute when running at a speed of 172 r.p.m. The fan is belt driven by a 20 h.p. motor, the speed being controlled by a Cutler Hammer speed regulator. The air washing and heating apparatus was supplied by the Thomas & Smith Co., Chicago, through Francis Hankin & Co., Toronto, and the fan by the Canadian Sirocco Co., Ltd., Windsor, Ont.

A "Powers" temperature regulating system is installed in connection with the heating system. Diaphragm valves are fitted to the tempering coils and the reheating coils. These valves are each controlled by a thermostat set to operate at 50 and 70 degrees F. respectively, the control being effected by means of compressed air supplied at 15 pounds pressure by a belt-driven compressor. There is also a thermostat fitted to the hot water service tank, set at 160 degrees F., and operated by city water pressure. The temperature regulating system was supplied and installed by the Canadian Powers Regulating Co., Toronto.

The lay-out of the mechanical plant was designed by the James A. McAlear & Co., consulting engineers, Chicago and Toronto, and carried out under the supervision of Mr. Melvern Thomas, the Canadian manager.


BOILER FEED AND VACUUM PUMPS.

Forced Versus Natural Draft for Steam Boilers

By J. B. Mayhew

This article formed the subject of a paper read before the Oklahoma Ice Manufacturers' Association, and in its contents sets forth the many advantages to be obtained through having a forced draft equipment fitted to steam boilers for all classes of service; the chief feature being immunity from weather vagaries.

IT is the custom the world over to use cheap fuel for firing steam boilers, a proceeding to which no objection need be made, provided that the principles which govern the efficient combustion of the fuel are practised. These principles teach us that quick combustion increases temperature. While the total amount of heat produced by the complete oxidation of a pound of carbon may be the same, whether the process is slow or rapid, the temperature is very much higher when quick combustion takes place. The heat given off by a slow cooking fire is much less than the same fuel under a blast This fact can be realized when it is considered that the rate at which heat is conducted through the plates or tubes of a boiler is in direct proportion to the difference in temperature between the flue gases and the water, and it naturally follows that the higher initial temperature of the gases, the greater will be the absorption of heat by the water. With strong draft, it is possible to use thick fires, which enables fuller use to be made of the oxygen passing through the fuel bed, and in consequence, the amount of air furnished per pound of coal, is diminished. This reduction in quantity of air is very beneficial, the result being that less heat is carried off by the stack to warm up the outside atmosphere.

Furnace Air Supply.

Experiments in the United States Navy demonstrated that in the hand-fired furnace, with stack draft, twice the theoretical amount of air was required, or twenty-four pounds of air per pound of bituminous coal, and it will be found, by analyzing the flue gases of the average plant, that two or three times the above amount is being used.

The temperature of combustion of soft coal with the theoretical air supply (11.75 pounds air per pound of coal) is approximately 5,000 deg. F. With 18 pounds of air per pound of coal, this being the amount furnished by forced draft, the combustion temperature is around 3,500 deg. F.; and with 24 pounds of air per pound of coal, as required by natural draft, it is about 2,700 deg. F. In the majority of furnaces, however, with natural draft, the excess air is so great that if a pyrometer were used the furnace would not show more than 1,800 deg. to 2,000 deg. F. The interchange of heat between the boiler and gases being proportional to the difference in temperature, it can readily be seen that this is an item of importannce.

Strangely enough, the greater the excess of air, the higher will be the temperature of the outgoing gases, and less heat is absorbed by the water in the boiler. This is accounted for by the total volume of the gases passing through and around the boiler and tubes being increased, thus causing swifter travel, and in consequence, less heat is imparted to the water in the boiler, and the amount of interchange of heat is proportional to the time of contact.

In a majority of cases, plants having a limited range of fuels and well meant attempts to realize economy by using cheaper coal, are prevented by lack of draft. A sure indication of insufficient draft is the ash pile outside the boiler-house, which remains in a glow for hours and sometimes burns for days. In cases of this kind, surprising reductions can be made in the coal bill by improving the draft or increasing the grate area, although the latter gives more excess air. The best thing to do is to use more draft and get a hotter fire. Low-grade coal can be burned by using extremely high stacks or by mechanical draft, but with the exception of tall city buildings, where chimneys are, as a matter of course, carried to considerable heights, few boilers are provided with stacks high enough to create sufficient draft for its proper combustion.

The draft required for efficient combustion of any fuel is the suction or pressure needed to cause sufficient air to flow through the coal, and is chiefly dependent upon the size of the fuel. It therefore follows that the smaller the fuel particles, the greater should be the draft, due to friction caused by forcing air through the coal. Any required intensity of draft can be produced by a stack, as it is only a question of going to a suitable height and keeping the gases hot enough. The chief objections to a high stack as a draft producer are its absolute lack of flexibility under varying load conditions and the impossibility of increasing its capacity to keep step with the demand of a growing business, and its great ability to pull in air through boiler walls and draw gases over the surface of the boiler so fast that it is impossible to absorb the heat generated from the fuel.

Forced Draft Advantages.

The advantages of mechanical, or forced, draft are many, though largely dependent upon one another. The points of superiority of forced draft produced by fans, as compared with chimney draft, are as follows:—

Low first cost.
Small operating expense.
Cheap fuel.
Increased and improved combustion.
Smaller boiler plant.
More thorough utilization of waste gases.
Absolute independence of atmospheric conditions.
Better regulation.
Economy of space.
Smoke prevention.
Greater adaptability, and best of all,
A balanced condition of air on the boiler walls.

Cost Comparisons.

The larger the plant, the greater is the proportional difference in cost of a stack, as compared with mechanical draft. Comparison of a number of average plants show that fan draft with engine and short stack cost about 25 per cent. of chimney. For small plants where each boiler has its own stack of light iron, it is about an even break on first cost, but the results you get are far better, for the stack will not do the work for which it is intended. The cost of operating the fan engine does not amount to anything, as the steam can go to the condensers or heating system. With forced draft, fuel of lower grade or poorer quality can be burned. To many plants, the change has brought a saving of more than 40 per cent. in the fuel cost, and it is very poor work if it does not save 25 per cent. It improves combustion, making it possible to burn 50 per cent. more fuel per square foot of grate area and run your plant easily where it has been a drag before, and increases the boiler evaporating capacity 50 per cent. by getting the hotter fire.

Forced Draft and Weather Conditions.

Forced draft is absolutely independent of weather conditions. When days are hot and still, the plant with its short stack and natural draft cannot hold steam if the coal is bad, while if you have forced draft, you speed up the engine and there it is. The man firing a furnace with natural draft, which is the result of two columns of air or gas at unequal temperatures and weights endeavoring to equalize or balance, fights his fire and wonders when the weather will change so that he can get enough draft to hold steam. Natural draft is also affected by wind, and everything dependent upon such variable elements as atmospheric temperature and wind must suffer in the matter of uniform results. I have seen 25 per cent. variations in natural draft by sudden changes in the atmosphere.

Let me draw you a picture of a plant with the average boiler and setting, and a stack of 85 feet high. The fireman has been burning good nut coal and getting along very well, but the manager finds that his fuel bill is eating up the profits. His coal dealer informs him that he can sell him slack from the same mine for half of what he is paying for the nut coal, and they try it. In spring, when the air is cool, things go tolerably well; but July and August come along with not a cloud in the sky and there is not the sign of a breeze. The smoke goes 200 feet high before it breaks, and it looks as if someone would have to shovel it from the top of the stack. What is the trouble? The fuel has the heat units in it, for analysis show that; but it won't burn, and why? Simply because the atmospheric conditions have changed, and the two columns of air or gas are so nearly balanced that the draft will not force enough air through the bed of the fine coal to furnish enough oxygen to burn it, and the gases are leaving the stack in the form of carbon monoxide gas. A pound of carbon burned under these conditions only produces 4,400 B. t. u.'s, and what the fireman does not burn he wheels out to the ash pile. What the poor fellow needs is a blower under his grates so that he can force the air through his fine coal and get the oxygen to burn the carbon to a carbon dioxide gas which is formed by burning one pound of carbon with two pounds of oxygen. This produces 14,500 B. t. u.'s, eliminates the smoke, produces steam, and is capable of such regulation as to accommodate itself to both fuel and weather vagaries.

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Cleaning Producer Gas.—The cleaning of producer gas by straining it through a porous diaphragm of fine-spun glass was recently described before the American Society of Mechanical Engineers in a paper by Mr. H. F. Smith. Both gas and tar pass through the diaphragm, but in passing, the tar particles coalesce into large drops which cannot be carried along with the gas current. By means of this process any desired degree of gas cleanness can be secured. Water or other washing fluid is not required, and the process is not one of filtration.

Buying Coal on a Systematic and Scientific Basis

By Hugh Lamont

Concurrent with other steps being taken to improve and keep in the forefront, steam as the motive power in our manufacturing and general industrial enterprises, the question of a suitable and uniform quality supply of fuel in the shape of coal is receiving closer attention. In this article are indicated various considerations which contribute to make a careful study highly profitable to the consumer.

THE generation of electrical energy from our waterfalls, and its distribution at cost, through our provincial and municipal governments, has done much to popularize the utilization of electric power in various manufactures, where steam had heretofore been the source of energy. Not a few instances of the discarded steam boiler has been the result, and where the steam boiler has not been discarded, there has been a general "toning up of the system," as it were, resulting in the adoption of the latest and best appliances for increasing the efficiency of the boiler. In other words, the manufacturer who depends on steam for his power has been and is endeavoring to utilize to its fullest extent the heat units stored in his fuel, which is usually coal. In this he has been ably seconded by the fuel engineer, the manufacturer of boilers, the manufacturer of stokers; in fact, by the manufacturer of all kinds of accessories that have for their aim the minimization of losses in the generation and transformation of energy.

Everything that is being done is done with a view to the elimination of losses in the power plant; but the loss annually occurring through unbusinesslike methods of buying coal is one to which the average consumer of this country has given little thought. Practically everything the manufacturer buys is bought under a guarantee of some kind; but when it comes to buying coal, he still continues to buy on the basis of its looks or its general reputation, though it is a self-evident fact that, in order to get the highest efficiency in the power plant, it is first necessary to have efficient methods for the selection and purchase of our source of energy, namely—coal.

Constituents of Coal.

A proximate analysis tells us that coal consists of moisture, volatile matter, fixed carbon, ash and sulphur, and, according to the proportions of these component parts, we have coal varying from the highest grade anthracites through the different grades of semi-anthracite, semi-bituminous, bituminous, down to the lignites.

Moisture in coal is partly due to the moisture existing in the coal as mined, and is partly due to conditions of the weather during transit. At any rate, it has no heating value; but it is there in all coals, and in percentages over which the shipper has no control.

Volatile matter consists of carbon, hydrogen, oxygen, and nitrogen in varying percentages, and is given off as gases during the first stages of combustion. As some of these gases are inert, the heating value of the volatile matter is a variable quantity.

Fixed carbon is the chief source of energy in coal, as the process of combustion consists mainly in the burning of this carbon, together with the carbon and hydrogen of the volatile matter, and with the oxygen of the air introduced through the draft.

Ash is the residue left after all the combustible matter has been burned out of the coal, and consists of silicia, alumina, iron oxide and sulphide, sulphate of lime, magnesia, etc. Coals having ash high in sulphide of iron and fusible alkalies have a tendency to form a slag, which often adheres strongly to the grates, thus seriously interfering with the draft, and are more to be feared on this account than a coal where the ash is high in silica and alumina. Coals having a high percentage of ash are, as a rule, more difficult of combustion under ordinary conditions, than the lower ash coals.

Sulphur exists in coal as iron pyrites, sulphate of lime and as free sulphur. Free sulphur burns readily and has a heating value, though disagreeable odor, but, where found in combination with iron and lime, its tendency is to form a slag as noted above.

Calorimetric Test.

From the foregoing we have a knowledge of the component parts of coal as represented by a proximate analysis, but on account of the variable factor introduced by the volatile matter, an analysis of this description does not always represent the relative heating values of different coals tested in this way. As the heating value of a coal really represents the available energy stored therein, it follows that a comparison of different coals should really be made on a basis of their heating values. This can only be done by a calorimetric test, which consists in burning a weighed portion of the coal in a metallic bomb immersed in a measured quantity of water, and noting the rise in temperature of the water due to the combustion of the coal. The heating value of the coal, thus determined, is expressed as so many British thermal units, (B.t.u.) per pound of coal. By comparing the heating values found by calorimetric tests on various coals with the results of proximate analysis, we often find that coals, of apparently the same analysis, will vary considerably in heat units. This variation is due, as noted before, to the volatile matter.

In the selection of a coal, the consumer has also to take into consideration the adaptability of the coal to his furnace conditions. To determine this factor tests for furnace efficiency should be conducted under actual working conditions. The number of pounds of ashes removed for every hundred pounds of coal fired, taken in conjunction with the percentage of ash as determined by laboratory tests, will give a basis for comparison of the relative adaptability of coals thus tested. For instance: suppose a certain coal shows by laboratory tests ash of 10% value, which would mean that 90% was combustible matter; and that, from the fires, there was removed 25 pounds of ashes for every 100 pounds of coal fired. It would show that instead of burning 90% of the coal, we are actually only burning 75%, and 15% of the combustible matter is carted away in the ash and clinker. It follows that the nearer we approach the 100% mark on these tests the more adaptable the coal is to furnace conditions. In actual practice, an approach within three per cent. is considered good.

Specification Covering Supply.

Having determined by test the kind of coal that may be burned successfully in any given plant, it is important to the consumer that this standard of coal be delivered at all times, and specifications covering same should be made part of the contract under which he buys his year's supply. It is important also that the specifications be so drawn that it will be to the interest of the dealer to carry out his part of the transaction. In specifying the heating value of coal as a basis of a guarantee, the contract should be so drawn that all coal deliveries are paid for on the actual heat units contained in the dry coal. This automatic system of regulating penalties and bonuses is arranged for by specifying in the contract, the net B.T.U. to be delivered for one cent, thus:—

Suppose the contract calls for coal containing 14,000 B.t.u. per pound, at a price per ton of $1.90. This means that for every ton of coal delivered, the consumer is to receive 28,000,000 B.t.u. (14,000 × 2,000), for which he agrees to pay $1.90, or, for every cent expended, he is to receive 147,368 B.t.u. (28,000,000 ÷ 190c.). This then is the basis of the contract and all coal delivered thereunder should be carefully sampled and the B.t.u. value determined by calorimetric test, and all coal represented by each sample should be paid for in accordance with the heating value found.

For instance, suppose a sample represents 100 tons of coal, guaranteed as above. Actual tests, however, show that the coal contains but 13,800 B.t.u. per pound, or (13,800 × 2,000), 27,600,000 B.t.u. per ton. As the contract calls for 147,368 B.t.u. for one cent, the 100 ton unit, as mentioned above, is worth only (27,600,000 ÷ 147,368), 187 cents, or $1.87 per ton, the price which should be paid. Suppose, on the other hand, however, that the coal delivered shows by test a value of 14,200 B.t.u. per pound or (14,200 × 2,000), 28,400,000 B.t.u. per ton, then, as the dealer only agrees to deliver 147,368 B.t.u. for one cent, the value of each ton in this case becomes (28,400,000 ÷ 147,368), 193 cents or $1.93, the settling price.

It has been pointed out that, with one exception, the heating value of a coal represents its money value. The exception is in the ash. The higher the ash, the more difficult it is to burn out the combustible matter, and the reduction in price, in accordance with the calorimetric test, does not make up to the consumer the loss in furnace efficiency and added expense for removal of excessive ash content. It follows then, that there should be a limit placed on the per cent. of ash allowable, and some provision made for the rejection of coals exceeding this limit, or for acceptance at a reduction in price greater than that due to the B.t.u. This precaution is necessary to prevent the substitution of inferior grades where it has been demonstrated that a high grade coal is an absolute necessity in obtaining good furnace efficiency.

The consumer will likely find a reluctance on the part of the coal dealer toward a guarantee as specified herein, but, when thoroughly understood, a contract of this kind is eminently fair to both. It protects the dealer who is prepared to furnish high grade coal in competition with dealers handling inferior coals at the same price. It encourages him to deliver coal above contract grades by providing a premium for all coal thus delivered, and, on the other hand, the consumer will find it to his advantage to pay a premium of the extra heating value delivered.

This plan has proven successful in many localities, and will prove itself satisfactory wherever the specifications are carefully drawn, and the consumer and dealer alike, have a knowledge of the basic principles that tend to make for efficiency in the coal pile.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

* * *

PROBLEM OF THE THRUST BEARING.

HENRY T. NEWBIGIN in a recent paper read before the Institution of Civil Engineers, drew attention to the inefficiency of thrust bearings as compared with journal bearings and their disadvantages, especially in high-speed machinery. A comparison was made between Coulomb's laws of friction and the late Professor Osborne Reynolds's hydrodynamic theory of lubrication, and coefficients of friction in bearings of various forms were given, while the way in which the friction in a journal bearing changes from dry or greasy friction to perfect lubrication as the speed increases was also discussed. The late Beauchamp Tower's discovery of liquid pressure in the oil-film was described.

Viscosity was defined, and the resultting general formula compared with the results of Mr. Tower's and Professor Goodman's experiments. The conditions necessary for the maintenance of liquid pressure in an oil-film were also examined and defined.

The subsequent developments of Reynolds's hydrodynamic theory of lubrication were referred to, and A. G. M. Michell's formulae for the resistance of lubricated plane surfaces were cited: the paper concluding with description, illustrations and the results of tests of thrust bearings constructed on Michell's principle.

* * *

Winnipeg, Man.—It is announced that the Winnipeg Electric Railway will undertake extensive hydro-electric developments. Plans are being prepared by the J. G. White Corporation, New York.

REFRIGERATION DEPARTMENT

ABSORPTION AND COMPRESSION MACHINES.*

By C. Braungart, Jun.

WE distinguish to-day between two systems of mechanical refrigeration—the compression system and the absorption system. I will not here describe the mechanical and physical points wherein these two systems differ from each other, but will rather discuss the question of knowing how to select wisely between them—i.e., when to install an absorption and when to install a compression plant.

It is not, as is often stated to-day, a question of the one system or the other being pre-eminently the best under any and all conditions. Much too freely claims of this character are being made by advocates of the compression system, and again by absorption machine enthusiasts. Too often a poor compression plant is compared with a good absorption plant, to the detriment of the former, or a poor absorption plant by contrast with a good compression plant is made the cause of erroneous conclusions. Because a plant of a certain type is a pronounced success in a particular locality or installation, it is no criterion that the same combination of parts, or a duplicate plant, will be equally successful for you.

Determining Factors.

The determination of the question, "which is the best type of plant to install," under given conditions, is not an easy one, and requires for its solution proper consideration of many intricate problems. First and foremost, of course, there is the water supply. This may be good, or bad in quality, plentiful or scarce in quantity, and cheap or costly to handle. Then there is the question of fuel or power, with all its possible variations; and last, there is the question of the size of the plant, character of the anticipated ice business, and quality of ice desired.

These different considerations, with their infinite complexities, make absurd the claim that there is only one type, or system, that will work out best under such an astounding variation of conditions as we can present to ourselves. This is the very reason why to-day our largest machine manufacturers are building and offering machines of different types. It is because they realize that, under certain conditions, one or the other type of machine will give better results.

Compression System More Flexible.

There can be no argument, I hold, on the statement that of the two systems the compression system is the more flexible. It can be adapted to a more varying combination of conditions than can the absorption system. This is at once apparent when we consider that the absorption machine must have steam power, while the compression machine is not dependent upon steam power, but may be operated electrically or in any other manner. Furthermore, under varying loads the compression machine can be more readily handled and adjusted, merely because it is more flexible and also because there is no such intimate chemical relationship between the component parts as with the absorption machine.

On the other hand, there may be many places where an absorption machine would fit in to best advantage, notably, where very low temperatures are desired, or in connection with existing industries that have available exhaust steam for use in the generator; but in such case, the water conditions must not be such as would entail a high steam pressure, causing high back pressure on the main plant, which could very readily produce a condition in which the combined operation would be very uneconomical. It is a recognized fact that absorption plants require more cooling water than compression plants. Therefore, should the cooling water be scarce, one should hesitate to install an absorption machine, unless other conditions were greatly in its favor. Neither should one install a low pressure, or so-called exhaust steam absorption machine where the water supply is very high in temperature, for the temperature of the water, as it governs the condenser temperature, also controls the steam pressure under which the ammonia generator operates, and the higher the water temperature, the higher the steam pressure, and the less the economy.

The Economy Feature.

Furthermore, I desire to state most emphatically that the best plant is not always the plant that makes the cheapest ice, or the most ice per ton of coal. To elaborate, suppose you were favored with a fuel supply which was extremely cheap, it would be far better to install a simple plant making fewer tons of ice than an elaborate plant, making a high return in ice per ton of coal, for the very simple reason that the interest, depreciation and fixed charges on the extra cost of the expensive plant would more than offset the saving in coal. This is the very point I wish to drive home; viz., that the economy of the plant, as usually stated in tons of ice per ton of coal, should be worked back into dollars and cents, and referred to the total investment of the plant, and the probable factor of the plant.

It will then show quite frequently that a cheaper plant, making less ice per ton of coal, is a better investment than an expensive plant. In fact, it is possible to conceive a situation in which the purchase of the most expensive and most economical machinery, from a coal consumption standpoint, is the very death knell of what would otherwise be a remunerative business venture.

Where after due consideration of all the questions, it is decided to install a high efficiency ice plant, what we all dreamily refer to as a 10 to 1 plant, do not make the mistake of thinking this increased economy is going to be all profit. Whether you install a compression or an absorption machine, in either case you will have to have an evaporation plant of more or less complexity, which will not, I assure you, simplify your plant, or make it cost less. Both the compression and the absorption machines have been brought to a very high state of development by manufacturers whose aim is always to produce plants that are money-makers for their owners, for that is good business on their part, and with either system it is possible to-day to bring the fuel cost per ton of ice to a very low figure, so that the selection of which type of machine to install should be left, in the last analysis, only to some one who is fully competent to decide on this important point.

The determination of this question is really the field of the consulting engineer, for it cannot, obviously, be expected of the purchaser and plant owner that he acquire all the figures and data necessary to a proper solution of the problem. The employment of competent advice will in nearly every case be reimbursed, and will save many losses and disappointments.

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*From a paper read at the Silver Jubilee of the Southern Ice Exchange, Chattanooga, Tenn.

* * *

OIL ENGINES FOR ICE PLANTS.

SPEAKING before the Eastern Ice Association on the subject of motive power for ice plants, Mr. Price, of the De la Vergne Machine Co., New York, said that one of the greatest advantages of electric power or electricity for the production of motive power has been the elimination of the labor. By putting in an electric motor, we can dispense with the fireman or the attendant at the producer; but with an ice plant this labor charge, with electric power, will be just as much for an electrically driven plant as it will for an oil engine driven plant.

The Saving Claimed.

It is possible with the latest type of oil engines to manufacture ice at a fuel cost of 14 to 20 cents a ton, and with oil at 3½ cents a gallon, such as can be purchased now from a number of different Oil Companies, the De La Vergne Co. is prepared to guarantee 17 cents per ton for ice, and have a number of plants accomplishing this. With electric power at 1 cent per kilowatt hour, it costs 61 cents per ton of ice. Seventeen cents a ton with the oil engine will effect a saving for motive power of 44 cents a ton. Take the case of the 200 ton ice plant, that would mean 80 dollars per day, or, if the plant should run 250 days per year, there would be $23,000 difference in cost of power for the year.

You may say that the item of depreciation has not been taken into account, but if you can put in a prime mover for $40,000, that will save you $22,000 a year, where does the depreciation and interest enter into it? In less than two years' time, the cost of the installation will be entirely wiped out, and after that time there will be a saving of $22,000 a year.

Typical Installations.

We recently contracted for four 280 h.p. oil engines, two of 100 h.p., and one of 140 h.p., for one ice plant, in N. Y. City, and also for two 280 h.p. and two 100 h.p. engines for another plant in New York City, and we have made such guarantees that on the 3½ cent oil basis, the price of oil to-day, the cost of fuel for ice will be 17 cents per ton.

We have the American Ice Co.'s installation at Philadelphia, which consists of an 18 in. by 38 in. compressor and a 230 h.p. oil engine connected by rope drive to the compressor, and, as a unit to furnish the power for the auxiliaries, a 100 h.p. engine to furnish the power for the alternator. It is large enough to drive a plant of twice the capacity. In Washington we have a 280 h.p. engine connected by rope drive direct to the 18 in. by 38 in. compressor, and also a generator belted from the main shaft, so that in the cooler seasons the one unit will furnish all the power for compressors and auxiliaries. When the heavy season comes on, the 100 h.p. engine furnishes the power for the alternator and the air blowers. There is, however, no saving in the use of an internal combustion engine over a steam engine if ice is to be made from distilled water. In order to reap the benefit of using internal combustion engines, it is necessary to make raw water ice, either by the plate process or raw water can process, and the oil engine, we think, has the advantage over the steam unit and the producer gas outfit, of eliminating the entire attendance charge and of requiring for fuel cost not more than one-quarter what the steam plant requires and not more than one-fifth of what is required by electric power.

WHO'S WHO.

W. ATTWOOD.
Manager Pump Department, Bawden Machine Co., Toronto.

* * *

ELECTRIC POWER FOR ICE CREAM FACTORIES.

A PREFERENCE for electric power to that of steam in ice factories was the opinion expressed by Mr. Grubbmeyer at a meeting of the Maryland Ice Cream Manufacturers' Association, recently. He said every proposition in which refrigeration is involved has three considerations, which we should have to settle in order to apply our proposition, and get the best out of it at the least expense and lowest operating cost. The first is the engineering aspect as evolved under the proper selection of apparatus. The second is the question of power, and the last consideration is the motive possibilities, and the financial state of the proposition.

Under the engineering possibilities, we have the question of the amount of refrigeration which is required to accomplish our purposes, and at the present day this is pretty well settled as to what sized machine to put in. The question of layout is an important feature, and every part of the system should have consideration to get the most satisfactory results. The motors should be of a correct size in order that the losses be low and the efficiency be high. In the last few years the electrical proposition has been making headway, and the results accomplished are encouraging. With the electric system, the cost of the installation is lower than with a steam plant, the refrigerating part of the proposition involving an investment in some cases of about 50 per cent. of what steam would cost. Steam, of course, requires large water capacity and much room.

Operation Feature.

The first cost of the installation feature I have touched upon is for the refrigerating apparatus. The other part of the subject is the cost of the power to operate. In the operation of ice cream plants, the power is mostly used in the summer time. The power used in summer runs double what it does in the winter, and in some cases three or four times more. The power is sold at a higher rate in the winter. This means that the ice cream man can buy his power at a much lower cost than other manufacturing establishments using the same power throughout the year or more of it in the winter time. When you consider what this means, it seems to me that the electric drive has the steam proposition beaten out on operating cost.

Another factor connected with electric power is space. The amount of space required for the electric plant is much less, in some cases perhaps one-half. Then, again, we have to consider the question of heat, and in a large installation where steam is employed, the boiler capacity required is probably one-fourth of what would be required under the steam system alone.

* * *

H. J. Glaubitz, general manager of the Water Commission, London, Ont., has been given five weeks' leave of absence by the board. He intends making a trip to his old home in Germany.

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OUR CIRCULATION DEPARTMENT.

ATTENTION is drawn to the fact that the circulation department of this journal is in charge of Mr. J. I. Coddington, Ph.B., to whom all correspondence relating to non-receipt of any issue by subscribers, advertisers, etc., should be promptly sent. By so doing, the editorial department will not only be relieved considerably, but a more immediate rectifying of the trouble will be brought about.

EDITORIAL COMPLAINTS AND CRITICISMS.

OCCASIONALLY we are recipients of a complaint or criticism relative to editorial matter published, but for the most part these reach us in a more or less roundabout, indirect, and therefore, unsatisfactory manner; to wit, they rarely come direct. Let us say at once that we are not only at your service in the most direct manner possible to receive complaint and criticism, but lay claim as well to an average mortal's courtesy. Further, it is a common, every-day experience outside of the editorial feature of technical journalism, to find that an indirect approach contributes either to a distortion of facts or to an increase of fiction, or both; a set of circumstances not originally intended.

Bless you, no, we are neither infallible nor stubborn, nor are we in any sense unapproachable and inclined to aloofness. Let us get closer together then by eliminating the middleman, and you, The Power House and we ourselves will be all the better for it.

THE ATTRIBUTE OF HONESTY.

SOME time ago, a contemporary drew attention to the revelations concerning the New York, New Haven and Hartford, and the Boston and Maine Railroads, and expressed the opinion that, while enforced honesty by means of legislation was not only undesirable, but impossible, there was need of more effective measures than those now in vogue to make the crooked walk straight. Not a day passes, but the business and commercial life of this and every other continent is besmirched through the lack and practice of simple honesty by men in high places. In the humbler walks of life we are more or less prone to expect a considerable display of dishonesty, but just why, in this particular feature, none of us may be able to give a reasonably intelligent answer.

The dishonesty that is rampant in high places is becoming so common and brazen that it passes for smartness, and in a certain sense it earns the latter title so long as the malpractices remain undiscovered. The stress of keen competition in any and every sphere of the activities of our being contributes largely to the practice of dishonesty in a variety of form, and as this determination to get ahead of the other fellow is growing in intensity all the time, the outlook seems not altogether one for decrease, but rather increase. Referring again to the New Haven railroad, we have the declaration of a high official of the Government, following a careful investigation of conditions that "the powers that were did everything except run a railroad."

Education, philosophy and cultivation of intelligence are not only now within the reach of all who care to avail themselves of their acquirement, but are in addition being appropriated and effectively applied in the testing of men and things material, and only the lack of the most elementary intelligence on the part of a large percentage of men in high places, or a surfeit of avarice blinds them to the fact that they are being shadowed by the detectives of public opinion. In politics and affairs municipal, votes are paid for directly and indirectly, and in too many industrial and other corporations, the prosperity of the financier, and not the commercial interests of his community or his country, much less the welfare of the employees is the sole ideal. Is it surprising, therefore, when the names of some public men are mentioned that suggestions of honesty—plain, simple, downright honesty, are ridiculed?

Finance enters into all enterprise as a necessity, but finance, it is too often forgotten, is but a means to an end, and not that end. How often, however, do we find it both the means and the end, and the latter in more ways than one. Many industrial enterprises would still have been in existence had high finance not crushed them out, and many of those which to-day are wobbly would have been firmly established and flourishing had the like sinister influence not been allowed to usurp the real purpose of their being. Legislation, however drastic, will never make men honest, if for no other reason than the fact that those who legislate for us come far short of infallibility with respect to wisdom, justice and even common-sense. It may be said in reply that our rulers are but a reflection of ourselves, but this is only true in part, for it cannot be said with honesty of conviction that they are so representative.

Business enterprises, if run as purely financial institutions, are a menace to the progress and development of any country, and affect unfavorably the welfare of its citizens, besides courting ultimate ruin for those directly interested. In support of this statement, we don't have to cast around very much or very far for convincing proof. Much has been written relative to the display of earnest, honest, whole-hearted effort on the part of employees, but little is to be found which calls for honest business methods and administration on the part of those to whom this duty and privilege has been given.

* * *

MISPLACED CREDIT.

WE read the other day of the triumph of a certain city over a public utility corporation doing business within its borders, in the matter of a point of law relative to the privileges granted to and the conditions to be observed by the latter. Credit, of course, was generally given the city's representative in the person of its legal luminary for the successful outcome of the court proceedings. It transpires however, that other and at least equally zealous champions of the city's welfare had carefully scouted the battle ground of the opposing party, and had so trained their guns and developed their plan of attack that in any case victory was inevitable. In other words, the opposing party hadn't a leg to stand upon in their contention, therefore, consummate forensic ability counted for little in the successful result.

We are inclined to think that there is a strong tendency in every sphere of enterprise and endeavor to misplace credit—a failure "to give honor to whom honor is due." It seems to be part of our general make-up to conclude that he is the hero who bears away the spoils of victory, and that they who blaze the trail are but insignificant conveniences and, therefore, of no account. We are so superficially intelligent as to be unable to discern otherwise, and, may we add, so stupidly content, as to desire to remain so. In every sphere of human endeavor and enterprise, social, commercial, industrial, political and religious we give credit to individuals in a collective or unit capacity for compassing some scheme for the general moral uplift, for the completion of some great railroad or transportation undertaking, for the inauguration of some movement which makes for the welfare and safety of workpeople in our factories, for the stand on some question of national policy by a political party which a more or less selfish interest most probably instigated, and for the unification of Christendom by the adoption of one creed and one set of doctrines, yet, are oblivious, the while, to the fact that we and many others also took a part in the game.

Some people would have us believe that to-day in commercial and industrial enterprise "the race is to the swift and the battle to the strong only." Those who dispense this line of wisdom are, however, either of the silver-spooned birth variety or of the semi-invalid type, who have never known what it is to earn a living or who have had a hand-picked portion placed at their disposal by some interested spirit. The misplacing of credit is both a crime and a curse, robbing as it does the deserving of their birthright and bringing ultimate discredit and ruin on its originators and the recipients. The oft quoted statement that "there is honor among thieves" has no existence in fact, and never had, else we would have more honor to our credit as individuals, as a community, and as a nation, and have fewer thieves. In like manner if we properly allocated the credit due each individual either in his craft or in his citizenship, there would not only be a greater co-operation and unity of interest, but a disappearance of that suspicion of motive and enmity bred of distrust.

In all business enterprise there are to be found two classes of employees—the producers and the non-producers, and it goes without saying that the former get the credit, if that happen to be a feature, and the latter are either ignored or are reminded of their uselessness, although unfortunately necessary existence on the payroll. Diagramatically and by ofttimes reiterated address and writing we are informed that direct personal touch with and tab on all the employees of our large manufacturing concerns is kept and that a magnetic influence emanating from the peak of the organization draws worthy character and service thereto. We are also told, and examples are quoted and multiplied, of men who neither would nor could be kept down in their ambition to rise to high place, but we are without record of those who failed, not because of their lack of the qualities necessary, but purely on account of a misplacement and in many cases through the appropriation by others of the credit due them.

Only the other day, to quote an example dealing with a topic which is filling a large place in the Canadian political and industrial world at the present time, viz., the application for Government assistance by the C.N.R., there was being widely circulated the report that the C.P.R. was exerting its powerful influence to oppose the desired financial help. Rightly or wrongly the latter railroad management were being so credited, and only when the highly significant words of the C.P.R. president were given voice to "that it was not the C.P. (Canadian Pacific), but the **Canadian People** who were in opposition to a further grant to the C.N.R., was it apparent that here was another obvious case of misplaced credit. In this instance, it was a desire to save its face on the part of the Canadian people and its representative Government.

It exemplifies misplacing credit by blaming another, and differentiates only from that in which another's reward is purloined. The baneful effects are the same however, in each case.

* * *

Judge no man by his relations, whatever criticism you pay upon his companions. Relations, like creatures, are thrust upon us; companions, like clothes, are more or less our own selection.

We are creatures of habit. We succeed or we fail as we acquire good habits or bad habits; and we acquire good habits as easily as bad habits. Most people don't believe this. Only those who find out succeed in life.—Herbert Spencer.

Being forced to go to work and forced to do your best will breed in you temperance and self-control, diligence and strength of will, cheerfulness and content, and a hundred virtues which the idle never know. — Charles Kingsley.

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

TENSION ON CYLINDER COVER STUDS.

By J. H. Rodgers.

IN replying to A. E. W. on his solution to the problem of the Tension on Cylinder Cover Studs, I do not wish to enter into any heated argument in support of my solution, but wish to call his attention and also that of others to what, I believe, to be an error in his view of the question. By closer examination of the article in the February issue of **The Power House**, the tension of 1,005 lbs. under correction by A. E. W. will, I think, be found correct.

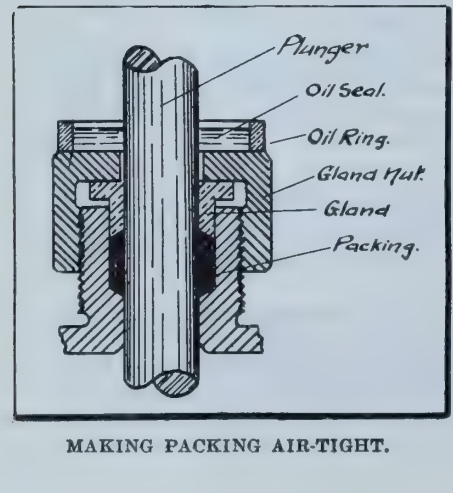
A. E. W. contends that, after the studs have been elongated 1-1000 of an inch, due to the initial tightening of the nut, an extra weight of 800 lbs. placed on the cover will put no additional stress on the studs, but if a weight of 2,000 lbs. is placed on the cover the studs will be elongated a further 1-1000 of an inch. Surely there has been some mistake in calculation, for why is it, that there is an elongation of 1-1000 of an inch between a weight of 800 lbs. and one of 2,000 lbs., and yet there is no elongation between 0 and 800 lbs?

* * *

MAKING PACKING AIR TIGHT.

By N. G. Near.

HAVE you ever had trouble keeping the packing of a hand pump perfectly air tight? Where the packing is leaky, you usually have a hard time making the pump "catch" without priming it. Here is a simple method for assuring air-tightness—make an oil-seal. An oil ring can be easily attached to the stuffing box cap by sweating on, or in a hundred other different ways; all that is necessary being to make the joint leakless. Pour in a fairly heavy lubricating oil, and as long as any of the latter remains in the cup you have thus fashioned, you may be assured that the packing is tight. If gasoline be the liquid pumped, lubricating oil will not harm it, in fact, lubricating oil is a good thing to mix with gasoline for use in connection with reciprocating gasoline engines.



MAKING PACKING AIR-TIGHT.

* * *

TENSION ON CYLINDER COVER STUDS.

By J. Roy Brodie.

IN the February issue of **The Power House**, there appears a question which I believe was up for discussion some years ago. Mr. Jones, who was the originator of the problem, thought there would be no increased tension on the studs till the steam cylinder pressure exceeded 100 lbs. per square inch. Now, if the above pressure causes increased strain, I cannot understand why any pressure lower would not have the same effect in proportion.

I do not consider it necessary to explain my theory with diagrams for the reason that I agree in every particular with the theory of Mr. J. H. Rodgers, but will add a little to his theory with the hope that it may aid in a more thorough explanation of the question before us. For instance, let us suppose the face plate was secured to the flange by studs having a tensile strength of 50,000 lbs. per square inch or sectional area, and if each bolt had a sectional area of a ½ square inch, the total strength of each bolt would be 25,000 lbs. With ten bolts, the total resistance to strain would be 25,000 × 10 = 250,000 lbs. The pressure exerted on each stud bolt by screwing up the nut being 1,000 lbs., therefore, on ten bolts the total pressure would be 10,000 lbs. The total pressure of steam on the face plate would be 100 sq. in. × 80 lbs. per sq. in. = 8,000. Deducting the combined effective forces of screwing up and total steam pressure on face plate—10,000 + 8,000 = 18,000 lbs., from 250,000, we get 232,000 lbs. excess strength of stud bolts.

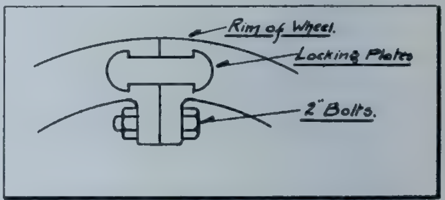
It is not reasonable to suppose that any pressure short of that required to elongate or fracture the stud bolts will lessen the screwing-up pressure. The tension on the stud bolts caused by the screwing-up strain is, therefore, constant, always tending to pull them apart or break them, whether live steam be in the cylinder or not. When steam at any pressure is admitted to the cylinder and comes in contact with the face plate or cover, the tensile strain on the stud bolts is increased proportionately, and is equal to the area of the face plate in square inch multiplied by the pressure per square inch. Now, the two forces as they affect the stud bolts act in the same direction, both causing a tensile strain outward, consequently they cannot balance each other, and, as there is nothing else to support this strain, the duty is fulfilled by the stud bolts, a conclusion about which there can be no doubt.

* * *

FLYWHEEL QUERY SOLUTION.

By "Centrifugal."

IN the February issue of **The Power House** there appeared at the foot of page 57 an enquiry from H. Westwood as to the stresses set up in the rim bolts and hub bolts of a flywheel 12 feet in diameter, running at 150 r.p.m. and weighing 10 tons. The hub and rim are



FLYWHEEL QUERY SOLUTION.

split, and the hub is held by four 2½-inch bolts, while the rim is secured by four 2-inch bolts. Mr. Westwood states that the initial stress in each of the hub bolts is 1,000 pounds and 700 pounds in each of the rim bolts.

Now, while I believe the following method of approaching this problem to be correct, I do not pretend to an expert knowledge, and hope some fellow-readers who are better up on the subject than myself will send along their solutions for publication.

Formula for Centrifugal Force.

The total centrifugal force (F) in a revolving body expressed in pounds is

$$F = \frac{W \times V^2}{g \times R}$$

Where F=Total centrifugal force in lbs.
W=Weight of revolving body in lbs.
V=Velocity of revolving body in feet per **second.**
R=Radius of gyration of the body in **feet.**
g=Acceleration due to gravity=32.2.

The radius of gyration (R) may be taken as the mean radius of the rim of the wheel. We are not told the size of the rim; but for the purposes of this solution let us assume that the rim is 10 inches deep. Then the mean diameter of the wheel will be

144 — 10 inches=134 inches.

and since R must be expressed in **feet,** we have

$$R = \frac{134}{2 \times 12} = \frac{67}{12} \text{ feet.}$$

Now, the force tending to disrupt a flywheel is not the total centrifugal force (F), but is (F) divided by 3.1416. The case is analogous to that of a boiler shell. Consider a certain length (1 inch long) of a section of a boiler. The total radial forces acting on this length are clearly found by multiplying the pressure of the steam in pounds per sq. inch by the circumference of the boiler in inches, or to put it into a formula:

Total force=P × 3.1416 × D.
Where P=Pressure per sq. inch.
D=Diameter of boiler in inches.

It is, however, well known that the force tending to rupture a boiler transversely is given by the expression, P × D. In other words, to find the force tending to burst the boiler, we divide the total pressure by 3.1416. Similarly in the case of a flywheel we must divide the total centrifugal force (F) by 3.1416 in order to find the force tending to rupture the wheel at its diameter. Thus, the formula becomes:

$$\text{Bursting tendency} = \frac{W \times V^2}{3.1416 \times g \times R}$$

In this formula V is the velocity in feet per second of the wheel at the mean radius of the rim (R). This radius we have assumed above to be 67 inches. The corresponding **diameter** is therefore

$$\frac{67 \times 2}{12} \text{ feet.}$$

This circle revolves at 150 revs. per minute, and its speed per **second,** therefore, is

$$\frac{3.1416 \times 67 \times 2 \times 150}{12 \times 60} = 88 \text{ ft. per sec.}$$

We are now in a position to fill in the numerical values in our formula, the values being as follows:—W=20,000; V=88; R=67÷12=5.68; g=32.2.

The force tending to disrupt one-half of the wheel from the other half is, therefore,

$$\frac{20{,}000 \times 88 \times 88}{3.1416 \times 32.2 \times 5.68} \text{ pounds.}$$

=269,607 pounds, or (say) 270,000 lbs.

Assuming that the bolts have U.S. standard threads, the area at the root of the thread will be 2,302 sq. inches for a 2-inch bolt, and 3.719 for a 2½-inch bolt. The total area of the eight bolts will, therefore, be a trifle over 24 square inches, and the stress per square inch of area will be

$$\frac{270{,}000}{24} = 11{,}250 \text{ pounds.}$$

Relative Considerations.

Of course, considerable assistance will be given to the rim bolts by locking plates shrunk into the rim on both sides as shown in the sketch; but even allowing for this, it is clear that the bolts are too highly stressed. The trouble is that in the problem, as stated, the speed of the wheel is too high. The speed of the extreme outside edge of the rim is over 94 feet per second. This would be all right for a solid wheel, but for a split wheel the speed should be considerably reduced. Probably 60 or 70 r.p.m. would be as fast as it would be safe to run a well designed split wheel 12 feet in diameter, if made of cast iron.

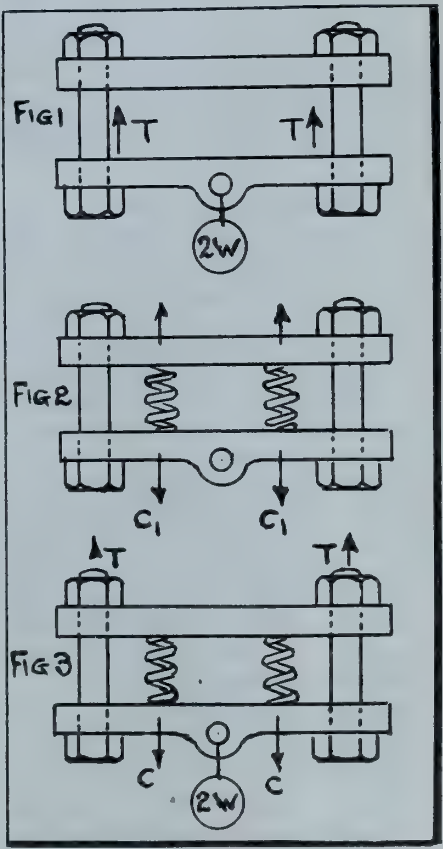
As the centrifugal force varies as the square of the velocity, it is obvious that a reduction of the speed to 70 r.p.m. would greatly reduce the bursting tendency, and consequently the stress in the bolts. The stress in the latter should not exceed about 3,000 lbs. per sq. inch of net section, for in addition to the tensile stress there is a shearing stress on the bolts. If we reduce the speed of the wheel to 75 r.p.m., we shall have cut the speed in half, and the centrifugal force will have been divided by 4. The stress on the bolts would then be only about 2,800 pounds per square inch, which would be in accordance with modern practice.

An objection may perhaps be raised by some readers that the above formula treats the whole weight of the wheel as being concentrated in the rim, and takes no account of the effect of the arms. This is, of course, true; but a complete and accurate treatment of the subject involves the use of higher mathematics, and the formula here given is the one generally employed. It gives a result quite accurate enough for practical purposes. When we consider the severe and entirely unknown stresses set up in the wheel by the cooling of the casting when it comes from the mould, it is obviously useless to figure out the centrifugal stress too closely. In wheels having a comparatively light rim, the bending stresses in the rim, due to the centrifugal force of the portions between two arms, may very possibly increase the calculated stress by 50 per cent.; hence it will be admitted that an approximation to the truth is all that can be looked for, or usefully employed.

TENSION ON CYLINDER COVER STUDS.

By A. E. W.

SINCE sending in my first contribution on this interesting subject for the Feby. issue, I have come across a solution by a well-known expert, whose conclusions will doubtless be of interest to my fellow-readers. The authority referred to is Professor



TENSION ON CYLINDER COVER STUDS.

Unwin, whose "Elements of Machine Design," is a widely used text-book on the subject. Doubtless many readers are familiar with the book; and if they will turn to page 182 of Volume I., they will find the matter gone into very fully. For the benefit of those who do not know the book, I have here extracted part of the chapter dealing with bolts and nuts, and have made a copy of the sketches accompanying the section.

Straining Action on Bolts.

Professor Unwin says:—"Suppose a plate be suspended by two bolts, and a load (2W) hung midway from it (Fig. 1). The tension on each bolt will be $T = W$, and the case presents no ambiguity. Commonly, however, the plates which are themselves to some extent elastic, are screwed tightly together, with a more or less compressible packing between them, and there is an initial tension in each bolt before the load is applied. This tension is balanced by the elastic reaction of the pieces fastened together. The case may be diagrammatically represented by imagining the plates rigid and elastic springs interposed, Fig. 2. Then the arrangement being symmetrical, each bolt has initially a tension, $(T = C_1)$, due to the compression of the springs by screwing up. Let a load (2W) be now applied, Fig. 3. The tension in the bolts will increase, they will stretch and so diminish the compression of the springs, and the tension in the bolts will have some value between (W) and $(W + C_1)$, depending on the relative elasticity of the bolts and springs.

"If (W) be increased till the stretch of the bolts is equal to the initial compression of the springs, (C) vanishes, and, for this or any greater load, the tension in each bolt will be $(T = W)$, as in Fig. 1. In most practical cases, however, the initial tension due to screwing up must be sufficient to prevent this, or there would be a sensible separation of the connected pieces.

"Let the extension of the bolts be (A) and the compression of the springs (B) per unit of load, then initially the compression of the springs is (BC_1). When the load is applied, the bolts stretch an amount $A\ (T - C_1)$, and the compression of the springs is equally diminished. Then,

$$BC = BC_1 - A\ (T - C_1)$$

$$C = C_1 - \frac{A}{B}\ (T - C_1)$$

$$T = W + C = W + C_1 - \frac{A}{B}\ (T - C_1)$$

$$= \frac{B}{B + A}\ W + C_1$$

"If the springs are very rigid compared with the bolts, as when the bolts connect two strong flanges, (B) is small compared with (A), and then $(T = C_1)$, or the initial stress due to screwing up **is not increased by adding the load.**

"If the extension of the bolts be equal to the compression of the springs per unit load, $(B = A)$, and then $(T = \frac{1}{2} W + C_1)$, and this case might occur when there is elastic packing to make a tight joint between strong flanges.

"Lastly, if the extension of the bolts be small compared with the compression of the springs $(T = W + C_1)$

"In the more ordinary cases, therefore, the load on the bolt depends chiefly on the strain put on initially in screwing up. Since workmen may exert considerable force in screwing up bolts, the strength of the latter must often be much more than would be necessary if the load only were considered."

From the above it will be noted that Professor Unwin states that the load does not increase the initial tension in the bolts when the heavy flanges are bolted together, as in the case of a cylinder cover **metal-to-metal joint.** Of course the stress in the bolts would be increased if the load exceeded the initial tension, but in such a case the joint would not remain tight.

Where an elastic packing is inserted in the joint, the load **does** increase the initial tension in the bolts, so that the two rules quoted in my first contribution would seem to hold good. In the accompanying figures, the upper bar is supposed to be fixed, the lower beam being suspended from it.

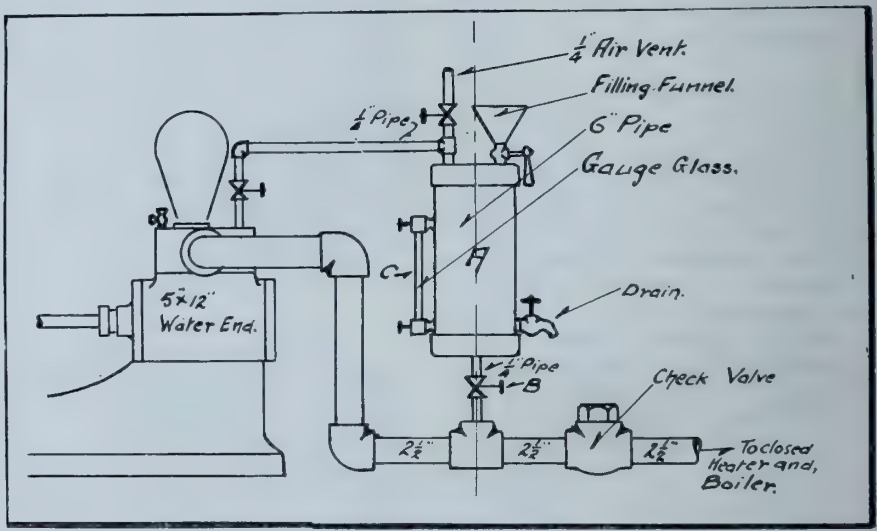
Discussions on subjects of this nature are certainly very interesting, as is clearly evidenced by the number of readers who are taking part in this one. I hope we shall have more of them.

A BOILER-COMPOUND FEEDER.

THE diagram herewith shows an interesting boiler--compound feeder devised by H. Mallinson, chief engineer at the Montreal Rolling Mills plant of the Steel Company of Canada. The principal advantage of this feeder lies in the fact that it delivers the compound to the discharge line, instead of to the suction line. When compound is drawn in with the suction, a certain amount of it is lost through leakage at the stuffing box gland. Moreover, the packing in an outside packed plunger pump is often rapidly destroyed by the compound, especially where a very strong mixture is used.

Referring to the sketch, at (A) is seen a piece of 6-inch pipe about 27 inches long and plugged at both ends. This is filled with boiler-compound through the funnel on top. Connection is made to the pump by a ¼-inch pipe as shown, the object of this pipe being to equalize the pressure above and below the compound. The latter thus gravitates into the feed line, the supply being regulated by the valve (B). As the compound descends in (A) it is, of course, automatically replaced by water through the pipe on top. The amount of compound remaining in the vessel (A) can be judged by the color of the liquid in the gauge glass (C). When (A) is full, the color is a dark brown, which gradually becomes lighter as the compound is replaced by the water. When the compound is all used up, the glass, of course, shows clear water. All valves are then closed and the water drained off. The air vent at the top is then opened and the vessel filled up again with compound.

This device has proved highly successful, and has been fitted to every feed pump in the Montreal Rolling Mills, as well as to a number in the other plants



A BOILER-COMPOUND FEEDER.

of the Steel Company of Canada. The size illustrated is used in connection with an 8-5-12 Simplex pump, but can easily be modified to suit larger or smaller units.

GAS ENGINE TROUBLES.

By W. M. Grey.

I WOULD like to have the opinion of some gas engineers as to causes of trouble which we have experienced lately at our plant. Installed are two vertical, four cylinder gas engines driving two belt-driven direct-current generators which run in parallel. At intervals, either one or other of the units will commence to pound, lose controlling power and close down. This happens in the short space of one minute. As pounding in the crank case often indicates a shortage of oil, we have kept the oil up to a good substantial level, and generally use one gallon per 8 hours on each engine. We run on the 24-hour system.

The engines are equipped with K.W. high-tension magnetos, which, including valves are apparently well timed. I have noticed that the generators do not parallel up very evenly. It may be that the equalizing wires behind the switch board are too small and if such be the case, would one generator have a tendency to motor the other, and throw the latter's engine out of step and cause pounding?

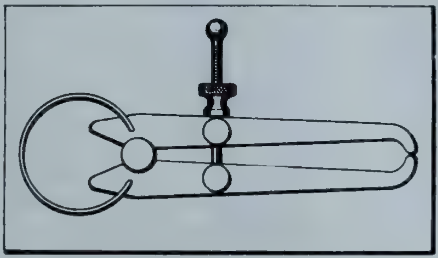
I have heard of several cases where vertical gas engines are in use and that they are consuming more oil than is really necessary. Makers of gas engines advise keeping the oil to a certain level; for which an oil indicator is placed in some convenient part of the engine frame. It very often happens, however, that the oil level cannot be ascertained, as the indicator glass is filled with a foam, due to the splashing which goes on in the crank case. I am of opinion that if makers of some of these high-speed gas engines would turn them out with an oil circulating device suitable to their particular type of product, it would be more satisfactory to themselves and also from the operator's viewpoint.

SPECIAL OUTSIDE CALIPERS.

By D. A. Hampson.

A HANDY caliper—one that every machinist should have—is that here illustrated. It is an "outside" spring caliper with straight legs and short points The writer has made a number of them from inside spring calipers by disassembling, filing notches on the opposite sides of the legs for the spring and the centre stud, and reassembling in reverse of their original position. A four-inch caliper is large enough for most of the work required of such a tool, and such a one converted would represent an outlay of about seventy-five cents and perhaps a half-hour's work. Many a time such a tool is worth twice that to a man who finds he has no tool in his kit that can be used for some certain job.

The uses of this caliper are many. For inspection purposes, it is particularly adapted. Assume that a small hole is to be drilled centrally in some rectangular blocks. How can its true location be determined? The anvil of a micrometer will not enter the hole. Outside calipers cannot be used—the big-bowed legs not permitting, while rivet joint inside calipers are too slow and too uncertain. The calipers shown are ideal for the task—sensitive, quickly changed and small enough ends to enter the hole so that any mechanic worthy of the name can detect a difference of .0015 in. between two measurements with them. On the planer and shaper they are very handy to measure the thickness of work being planed which is held in a vise or on parallels, but in such confined space (vertically) that bow calipers are out of the question.



SPECIAL OUTSIDE CALIPERS.

HEATING BUILDING USING CENTRAL STATION CURRENT.

By William Kavanagh.

THE installation of an electrically operated vacuum pump in conjunction with the heating system of a modern building using central station current for power and lighting purposes will lessen fuel expenses incurred during the heating season of each year.

The Vacuum System.

The most economical system of heating is known as the "vacuum system." Its installation involves the maximum cost, but its operation will be found to reduce heating expenses 25 per cent. over that of other known methods of steam heating. When the vacuum system of heating is properly installed, it will require the least amount of attention, and cost for maintenance will be reduced to the lowest possible degree. The employment of the electrically driven vacuum pump places the most economical system of heating within the range of any building not so equipped. The electrically operated vacuum pump has the great advantage of not requiring steam pressure for its operation, hence it can be seen that the pressure carried on the boilers may be reduced to that of the atmosphere; a desideratum tending towards economy of fuel.

Steam at atmospheric pressure has a sensible heat temperature of 212 degs. F., and a latent head capacity of 966 degs. F., therefore the total heat in 1 lb. of steam at atmospheric pressure will equal 1178 degs. F. If our system of heating is such as to rapidly convey away the water of condensation, and assuming the temperature of the returned water at 200 degs. F., then the total extraction of heat from 1 lb. of steam will equal 987 degs. F. From this we learn that all of the latent heat has become sensible heat by reason of condensation, and its useful effect has been realized in the heating of the building employing the vacuum method of heat circulation. In order to obtain such economy, it is absolutely necessary to have the radiators and piping free of air and water of condensation, but such a condition can only be had when the vacuum pump is employed.

Buildings equipped with the single and double pipe systems, warm air and forced circulation of hot water cannot approach in the matter of fuel economy those having the vacuum system installed. Incidentally, it should be mentioned that the attachment of the electrically operated vacuum pump to the pipe systems above mentioned will convert them into that of the vacuum system, involving only slight changes in the piping.

Vacuum System Advantages.

The vacuum system has many advantages over all other methods of steam heating, some of which may here be mentioned.

The low pressure carried on the boilers precludes all possibility of rupture or accident which are inherent in the systems using high pressure steam or forced water circulation.

In the vacuum system, the liability of leakage is remote; quietness of heat circulation is attained, and the heating effect is rapid, positive and equal over the entire plant. Such advantages are not within the scope of the other systems.

Miscellaneous Heating Systems.

The single pipe plan of heating is of two kinds, known as the "free" and "air valve" systems. In the free system, the air valve which is attached to the radiator is in turn connected to a pipe which is open to the atmosphere; the object being to facilitate heat circulation by permitting the entrapped air in the system together with the water of condensation to escape freely to the atmosphere. With the "closed or air valve" system, the air valve attached to the radiator is not connected to any other pipe, but is supposed to automatically perform the functions necessary to permit the steam to traverse the heater, and thus the dissipation of heat in the radiator is obtained.

The warm air system involves the use of a fan driven by some source of power. The fan discharges cool air through a bank of pipes containing steam, the warmed air being then conveyed through ducts conveniently located for the purpose of heat distribution.

Heating by means of warm water is accomplished in either one of two ways; one is known as "free circulation." With the other is that of "forced circulation." With the free circulation plan, advantage is taken of the gravity of the ascending and descending columns of water, thus obtaining an automatic circulation. With the forced circulation, a pump is used to circulate the heated water throughout the system, such circulation being continued as long as heat is required.

Heating by means of the electric current will materially reduce the cost, and more especially during the fall and spring months of each year. The electric current is extensively used for the heating of offices, baths, sleeping apartments, hospitals, etc., and when current can be obtained at a reasonably low figure, its continued use will be found to give satisfactory results owing to its adaptability to varying temperatures, non-vitiation of the atmosphere, cleanliness and simplicity of installation; all of which advantages combine to make it a superior media for the purpose.

From what has been said it can be seen that the maximum economy in the heating of a building cannot be obtained when fuel must be burned in order to force a circulation of steam through the heating system. Under the conditions where air can enter the piping and radiators and the water of condensation is not removed with sufficient rapidity, an unnecessary expenditure of fuel is required to overcome the resistance offered by the presence of these bodies. The employment of the electrically or steam driven vacuum pump eliminates such resistance and reduces the cost of fuel to the lowest possible degree.

◆

KINK FOR PUTTING ON OVERALLS

By James E. Cooley.

EVERY workman knows that each time when putting on a pair of overalls the legs of the trousers become drawn up and have to be pulled down and smoothed out, as they feel uncomfortable when humped-up. A useful kink to prevent this, and shown in the illustration, is to fold the trouser-leg about the ankle and fasten with a bicycle-clip. The overalls will then slip on easy. The clip should be left on, as it prevents dust and dirt from getting up inside the trouser-leg

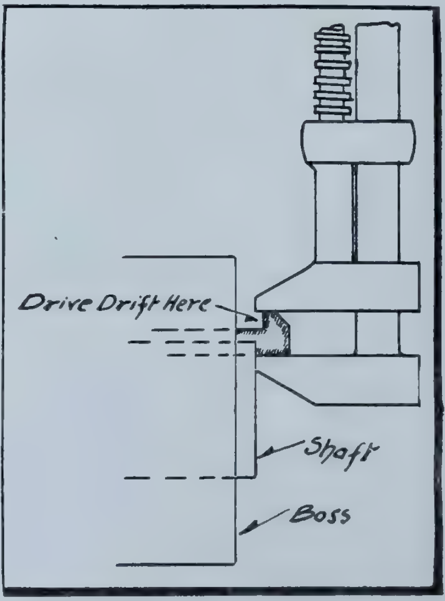
KINK FOR PUTTING ON OVERALLS.

◆

HOW TO PULL A TIGHT KEY.

By C. H. Lloyd.

I NOTICED in the February number of **The Power House** a kink sent in by N. G. Near, showing a method of pulling a tight key. This reminded me of a similar method which I have often used with success. Place a common monkey wrench on the head of the key, as shown in the sketch. Between the head of the key and the wrench drive a drift made of an old file tang or some other piece of steel, and steady the wrench with the hand, so that the key will not bend. The wrench holds the drift in place and prevents it flying out. It will be seen that the drift must not be thicker than the height of the head on the key. With this device it is possible to draw very stubborn keys without damage.



REMOVING A TIGHT KEY.

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Readers Queries

Horse Power Query.—To settle a little dispute between two engineers, an answer to the following query is desired: A car of 20,000 lbs. weight ascends an inclined plane of 8 deg. grade, 3½ miles long, in 15 minutes. If the friction be 3% of the load, what is the horse power absorbed?—C. Whyte.

Horse Power Query.—Frank Baker, Winnipeg, Man., requires the horse power of an Atlas Engine whose cylinder is 18½ inches diameter and 16 inches stroke; the r.p.m. being 190 per minute. Will our correspondent please furnish steam pressure, also cut-off if available?—Editor

Boiler Horse Power. — "Constant Reader" Edmonton, Alta., sends particulars of a 72 in. diameter by 18 ft. return tubular boiler, and wishes to know what are its respective horse-powers with working pressures of 125 and 100 lbs., per sq. inch. The information furnished includes thickness of heads and shell; number and pitch of tubes, but no diameter of same, although they are probably either 3½ or 4 inches diameter; grate area of 48 sq. ft.; diameter of safety valves 4 inches; shell riveting, head shell. It will be noted that much of the data here enumerated is unnecessary for the horse-power calculation. We are sure that a large number of our readers are in a position to fill this request, and in consequence look for a ready response.

Questions and Answers.—Our attention has been called to an error in the answer to question 9, on page 17 of the January issue of the Power House. A displacement of the decimal point in typesetting gave the answer as 16.83 horse power instead of 1.683 horse power.

◆

Question.—What force (P) will be required to raise a weight of half a ton by means of Weston's blocks when the compound pulleys have an effective radius of 3½ in. and 3¼ in. respectively; (1) when friction is neglected and (2) when the efficiency of the block is .35 per cent.?

Answer.—

$$(1) P = \frac{1120\ (3\tfrac{1}{2} - 3\tfrac{1}{4})}{2 \times 3\tfrac{1}{2}} = \frac{280}{7} = 40 \text{ lbs.}$$

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent practical questions, and give same direct, reliable answers. Catch questions will be avoided. Attention is drawn to the concurrent course in arithmetic, a concurrent study of which is recommended with that of the Question and Answer Series.

Question—Should a valve in its travel open a full port to live steam?

Answer—No, because the ports are designed, so as to allow of a free escape of exhaust steam, and if a full port be given, or be necessary for live steam, then for exhaust, the port is not large enough.

* * *

Question—Why is it necessary to have a larger area of port for the exhaust, as compared with the live steam?

Answer—Because the live steam having done its work in the cylinder has fallen in pressure, and become naturally of greater volume, and requires a larger space or area for escape.

* * *

Question—What advantage has the Corliss valve and its arrangement on a steam engine over that of a slide or piston valve, and what are its disadvantages in comparison?

Answer.—It reduces the port clearance to a minimum, gives a practically full steam admission opening and sharp, clean, instantaneous cut-off; permits of water of condensation being drained off through the exhaust ports; is adaptable to close governing and gives independent exhaust valve adjustment. Its principal disadvantage is in the number of revolutions per minute; these being limited to 150 probably as a maximum, due to the uncertainty of the trip gear engaging and disengaging properly.

* * *

Question.—A railway train starting from rest along a level piece of track acquires a speed of 30 miles per hour in five minutes. What has been the **mean pull between the locomotive and the train,** if the resistance to motion is 10 lbs. per ton and the train weighs 225 tons. Take a ton as meaning 2,240 lbs.

Answer.—The constant pull due to resistances$=10\times225=2,250$ lbs.

Mass of train$=m=\dfrac{225\times2240}{32}=15,750.$

Velocity of train$=v=30$ m.p.h.$=\dfrac{30\times5280}{60\times60}=44$ ft. per second.

Momentum of train$=m\times v=15750\times44$, and time taken to produce this momentum$=5\times60=300$ seconds, therefore the mean pull producing change of motion is $\dfrac{15750\times44}{300}=2,310$ lbs., and the total mean pull between the engine and train is $2250+2310=4650$ lbs.

* * *

Question.—A screw jack has a screw of ½-inch pitch. If a force of 50 lbs. be applied at the end of a 36-inch lever and the efficiency of the jack is 40 per cent., what weight can be raised by it?

Answer.—Neglecting friction, the power put into the mechanism is equal to the power given out by it. That is to say, the force applied at the end of the lever multiplied by the circumference it describes in one revolution is equal to the pitch of the screw multiplied by the weight raised. In the present case, the efficiency is only 40 per cent., the other 60 per cent. being lost in friction. The weight actually raised by the jack will, therefore, be .40 of the weight theoretically raised. Calling the latter W lbs., we have

$W\times\frac{1}{2}$ in.$=70\times2\times36\times3.1416\times.40.$

$\dfrac{W}{2}=633.35.$

$W=1266.7$ lbs.

* * *

Question.—What is the distinction between **energy** and **power?**

Answer.—Energy is the capability of doing work which a body may possess by reason of its position, condition, or motion. It is of two kinds. Thus, there is **potential energy,** or that form of energy which a body possesses in virtue of its position or condition. For instance, when a pile driver drop weighing 50 lbs. has been raised 20 feet it has a potential energy of 1,000 ft. lbs.; for it takes that amount of work to lift the 20 lbs. through 20 feet; and, if then allowed to fall, the drop will naturally give out the same amount of work. An example of potential energy due to the condition of a body is found in the coil spring of a watch or clock.

e energy **due to** the motion of a body is called **kinetic energy.** For instance, in the first example cited above, the pile driver drop weighing 50 lbs., in falling freely through 20 feet, had stored up in it, due to its motion, an amount of work equivalent to 1,000 ft. lbs.

Power is the **rate** of doing work, or the work done in a given time. The unit of power in this country is the horsepower and is the rate of doing work, equivalent to 33,000 ft. lbs. per minute.

* * *

Question.—In a wheel and axle the radius (R) of the wheel is 20 in.; the radius (r) of the barrel is 4 in.; and the weight to be lifted is 300 lbs. Find the force (P) to be applied?

Answer.—P $\dfrac{300\times4}{20}=60$ lbs.

* * *

Question. — The crank or handle which turns a windlass is 14 in. long. What must be the diameter of the axle when a man exerting a force of 60 lbs. upon the handle raises a weight of 2 cwts.?

Answer.— $\dfrac{14\times2\times60}{112\times2}=7\frac{1}{2}$ in.

* * *

Question. — What weight may be raised by a block and tackle with three sheaves in each block, when the force (P) applied is 30 lbs.?

Answer. — $W = 30 \times 6 = 180$ lbs.

* * *

Question.—The two blocks (A) and (B) of a block and tackle weight 25 lbs. each, and the weight (W) is 200 lbs. The whole is held in equilibrium by a certain force (P) applied at the fall of the cord. What will be the pressure on the hook which supports the blocks?

Answer. — The total load to be raised $= 200 +$ weight of bottom block $= 200 + 25 = 225$ lbs. There are six cords, therefore, $P = \dfrac{225}{6} = 37\frac{1}{2}$ lbs.

The total load suspended on hook will consequently equal $200 + 25 + 25 + 37\frac{1}{2} = 287.5$ lbs.

* * *

Question. — The upper block of a rope and pulley lifting tackle has three pulleys, and the lower block has two pulleys. What force (P) in lbs. applied to the fall, will lift a weight of 4 cwt.?

Answer.—$P=\dfrac{4\times112}{5}=80\ 3/5$ lbs.

* * *

Question. — In a Weston's pulley block, the effective radii of the compound pulleys (i.e., from the centre of pulley to the centre of chain which passes round it) are 4 in. and 3½ in. respectively. Find what weight (W) can be lifted by a force of 20 lbs. (neglecting friction).

Answer.—

$W = \dfrac{2 \times 20 \times 4}{(4-3\frac{1}{2})} = \dfrac{160}{.5} = 320$ lbs.

Question.—The base of an inclined plane is 20 feet long, and the height 6 feet. Find the length (L) of the incline?

Answer.—L = 202 × 62= 20.88 feet.

* * *

Question.—The base of an inclined plane is 20 feet long and 6 feet high. What force (P) acting parallel to the plane will pull up a body weighing 300 lbs., when the co-efficient of friction between the body and the plane is .25?

Answer. — Work due to gravity = 300 × 6 = 1800 lbs. Work due to friction = 300 × .25 = 1500 ft. lbs. Total work = 1800 + 1500 =3300 ft. lbs. The length of incline is 20.88 feet, as above, therefore,

P = 3300 = 158.04 lbs.
———
20.88

* * *

Question.—A train of wagons weighing 80 tons is supported on an inclined plane rising one foot for every 60 feet of length, by a wire rope attached to a stationary winding engine. Find the tension on the rope?

Answer.—
Tension = 80 × 2240 × 1 = 2986.6 lbs.
————————
60

SUPERHEATING STEAM IN LOCOMOTIVES.*

By Henry Fowler.

THE utilization of steam superheated, or of a higher temperature than saturated, has engaged the attention of engineers since the inception of the use of the expansive power of steam, i.e., since the middle of the eighteenth century. Its application in locomotives was suggested over 85 years ago, and for half a century many attempts were made to employ it in this class of engine. Owing to trouble arising from the packing and the lubrication, these were not successful, and the prominent position it occupies at the present day is very largely due to the investigations of Dr. Wilhelm Schmidt, of Cassel, and to the practical trials of his apparatus made by Mr. R. Garbe, of tthe Prussian State Railways. Various types of superheaters were tried, but the one now in most general use is that in which the steam receives its superheat when passing through small tubes placed in large smoke tubes through which the heated gases travel on their way from the firebox to the chimney. This type is general in England, where, in addition to the Schmidt system, the Swindon and Robinson systems, which differ from the Schmidt in detail only, are also employed. The utilization of the heat in smoke-box gases has been tried repeatedly, but without much practical success.

Under ordinary conditions, when an engine is running, the steam passing through the superheating elements carries away with it sufficient heat to keep the metal of the elements comparatively cool. When, however, a locomotive is running down an incline without steam, this does not occur, and it is necessary to prevent the gases from passing through the fire-tubes, which is effected by a damper or some other type of retarded. Arrangements are generally made for working the dampers or retarders automatically. The connection between the superheater elements and the header from which steam is distributed is a matter of importance, and the methods by which this is done constitute one of the chief differences between the various fire-tube superheaters. Essentially, however, they consist of those in which a joint is made between the pipe and the collector, and those in which the former is expanded into the latter.

Provision Against Trouble.

Piston-valves are employed almost exclusively in locomotives using superheated steam. These have to be of special design, owing to the greater fluidity of superheated steam and to the difficulty of efficiently lubricating any surface to which highly superheated steam has access and which has a heavily loaded machine-part passing over it. For the same reasons special attention has to be paid to the design of the piston-head. The high temperature of the steam necessitates glands of special design wherever they are required, as well as arrangements for cooling the glands by allowing access of air where possible. The packing used requires to be of special high-melting composition, and here, as elsewhere, it is necessary to design the parts so that as little pressure as possible exists between two surfaces which are exposed to the temperature of the highly-superheated steam. The oil used for lubrication is generally a mineral oil which has a high flash-point and which is fed into the various parts by a mechanical lubricator which will ensure a definite, determined amount of the lubricant being delivered regularly at the necessary points. The provision of a pyrometer which allows the engine-driver to know at what degree of superheat he is working is advisable. Owing to the use of piston-valves which do not permit the relief of compression or suction in the cylinders when running with the regulator shut, it is necessary to provide by-pass and vacuum relief valves. Some of these valves are also suitable for dealing with any water which may be carried over into the cylinders, whilst in other cases special relief valves are fitted. The large tubes in which the superheater elements are placed give little trouble.

The greater volume of superheated steam, when compared with saturated, has in many cases led to the adoption of larger cylinders and lower boiler-pressure. This leads to economy in boiler-repairs, which should counterbalance the increase of maintenance necessary for the extra apparatus required when superheated steam is used. The degree of superheat usually employed is 230 degrees to 260 degrees F. No figures at present seem to be available for the variation in the economy with varying degrees of superheat.

Chief Advantage.

The chief advantage claimed for the use of superheated steam in locomotives is the economy in coal-consumption, and on the Midland Railway, a number of trials have been made to ascertain what this is with the various types of engines, the comparison being made on the consumption per ton-mile under circumstances as nearly comparable as possible. These trials show that a saving of 23 per cent. in the coal consumption and of 22 per cent. in the quantity of water used, was obtained in one case, whilst in another, where the difference between the locomotives was solely in the superheater, the saving of coal was as high as 30 per cent. This high figure was probably due to the engine which used superheated steam having more reserve of power than the one employing saturated steam. From diagrams of these two engines it can be shown very clearly how much more fluid superheated steam is than saturated.

Experiments have been carried out to ascertain the effect of superheating the steam supplied to the high-pressure cylinder of a three-cylinder compound locomotive, and it has been found that a saving of coal of 25.9 per cent. and of water of 22.3 per cent. has resulted when comparison is made with a similar engine using saturated steam. In tests carried out with goods-engines, the coal-saving has been from 14.3 per cent. to 18 per cent.

Mechanical Stoking of Locomotives.—It was inevitable that when a satisfactory mechanical stoker for large locomotives was developed, it would have extended application. We understand that one large locomotive stoker Company has at the present time over 400 stokers in regular operation on locomotives in the United States, and that 200 of these are in use on the Baltimore & Ohio Railroad.

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*From a paper read recently before the Institution of Civil Engineers.

Arithmetic for the Machinist and Operative-Engineer

By J. H. Rodgers

Doubtless some of the elementary work in the first few articles of this series may appear more or less superfluous, but it must be remembered that numerous simple rules and formulae appear from time to time in Technical Journals, which are discarded and dubbed impractical by many operators for the simple reason that the elementals are either unknown or have been forgotten. The purpose of this course will have been achieved if the above tendency is even in part combatted.

IN our February issue the introductory details of the arithmetic course were featured, and progress was noted in the instructional work up to and including multiplication of fractions.

Division of Fractions.

Invert the divisor and proceed as in multiplication.

Example:—Divide 9-16 by ⅜. Inverting the divisor and multiplying, we have

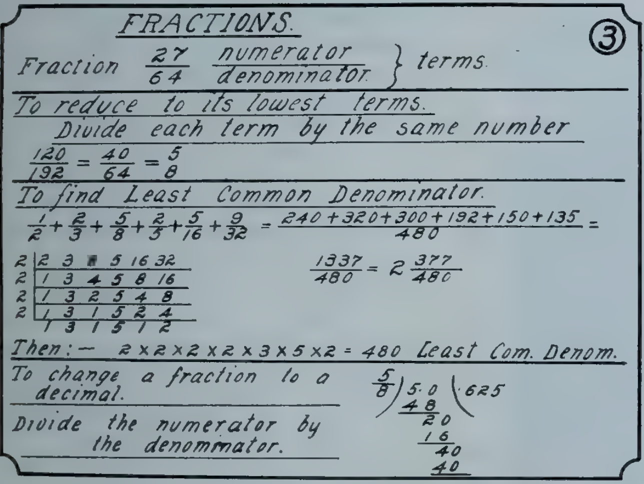
$$\frac{\overset{3}{\cancel{9}}\times\overset{1}{\cancel{8}}}{\underset{2}{\cancel{16}}\;\;\underset{1}{\cancel{3}}}=\frac{3}{2}=1\tfrac{1}{2}$$

Again, $\dfrac{\tfrac{3}{4}\times 5}{\tfrac{15}{64}}=$

$$\frac{\overset{1}{\cancel{3}}\times\overset{1}{\cancel{5}}\times\overset{16}{\cancel{64}}}{\underset{1}{\cancel{4}}\;\;1\;\;\underset{1}{\cancel{15}}}=\frac{16}{1}=16$$

In this case, the product of ¾×5 is to be divided by 15-64.

Examples of this kind may seem to be wandering from the subject of shop work, but as future problems and formulae will require similar solutions, a paragraph here will be of some help when these subjects are met with.


FRACTIONS.

③

Fraction $\frac{27}{64}$ $\frac{\text{numerator}}{\text{denominator}}$ } terms.

To reduce to its lowest terms.

Divide each term by the same number

$\frac{120}{192}=\frac{40}{64}=\frac{5}{8}$

To find Least Common Denominator.

$\frac{1}{2}+\frac{2}{3}+\frac{5}{8}+\frac{2}{5}+\frac{5}{16}+\frac{9}{32}=\frac{240+320+300+192+150+135}{480}=$

2 | 2 3 ▪ 5 16 32
2 | 1 3 4 5 8 16
2 | 1 3 2 5 4 8
2 | 1 3 1 5 2 4
1 3 1 5 1 2

$\frac{1337}{480}=2\frac{377}{480}$

Then:— 2×2×2×2×3×5×2 = 480 Least Com. Denom.

To change a fraction to a decimal.

Divide the numerator by the denominator.

$\frac{5}{8}$) 5·0 (·625
48
20
16
40
40

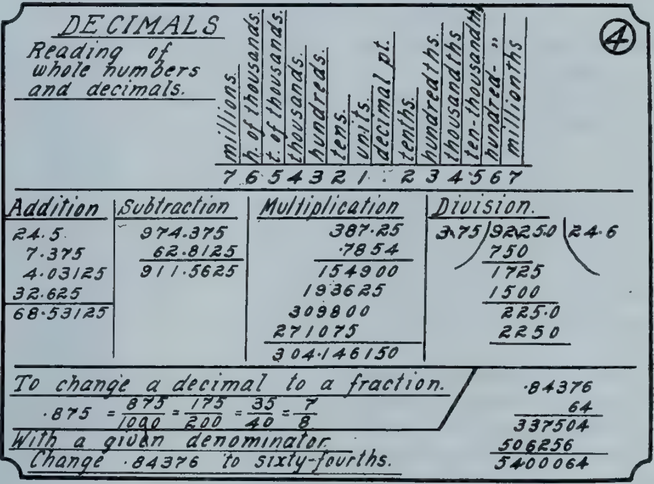
ARITHMETIC CHART 3.

Decimals.

With the exception of the fractions usually met with on the mechanics' steel rule, that is, quarters, eighths, sixteenths, thirty-seconds, etc., the use—and abuse—of common fractions are becoming extinct in the mechanical trades. The use of decimals has become more general, due to the micrometer and other precision tools of accurate measurement. Decimals are tenth fractions; that is, the decimal, or part of a unit, if expressed as a common fraction would have for its denominator ten or a multiple of ten—as 10, 100, 1,000, etc.

In using decimals, the denominator is understood by the number of places represented in the decimal. To express a part of a whole number decimally, a period (.) called the decimal point, is placed directly after the unit figure, and what would be the numerator of a common fraction is placed to the right of the decimal point. The first figure to the right of the decimal point. The first figure to the right of the decimal point represents tenths; the second hundredths; the third thousandths, etc.; similar to a whole number but reading from right to left. Care must be taken when reading or expressing the value of a decimal that the fractional term (ths.) is used.

When ciphers appear in a decimal, their location has much to do with the value of the expression. Thus, expressing ½ as a decimal, we have .5; but .05 would be 5-100 or 1-20. The value of the decimal is taken from the position of the figures in relation to the decimal point, and not from the figures alone. Chart 4.


DECIMALS

④

Reading of whole numbers and decimals.

millions.	h. of thousands.	t. of thousands.	thousands.	hundreds.	tens.	units.	decimal pt.	tenths.	hundredths.	thousandths.	ten-thousandths	hundred- "	millionths
7	6	5	4	3	2	1	·	2	3	4	5	6	7

Addition
24.5
7.375
4.03125
32.625
68.53125

Subtraction
974.375
62.8125
911.5625

Multiplication
387.25
.7854
154900
193625
309800
271075
304.146150

Division.
3.75) 92.250 (24.6
750
1725
1500
225.0
2250

To change a decimal to a fraction.

$.875=\frac{875}{1000}=\frac{175}{200}=\frac{35}{40}=\frac{7}{8}$

With a given denominator.

Change .84376 to sixty-fourths.

.84376
64
337504
506256
54.00064

ARITHMETIC CHART 4.

Addition of Decimals.

Place the numbers to be added so that the decimal points are directly over each other, and add as in whole numbers. The decimal point in the sum will be directly under the others.

Subtraction of Decimals.

Proceed as in ordinary subtraction, keeping one decimal point directly above the other.

Multiplication of Decimals.

Multiply as in whole numbers regardless of the position of the decimal point. In the product, point off from the right as many places as there are decimal places in the multiplicand and multiplier, adding ciphers if necessary.

Division of Decimals.

Place the divisor to the left of the dividend. If the divisor is a decimal, cancel or remove the decimal point, and move the decimal point in the dividend to the right an equal number of places; then divide as in whole numbers. Consider the point in the dividend as a figure, and place it in the quotient when met with in the process of the division.

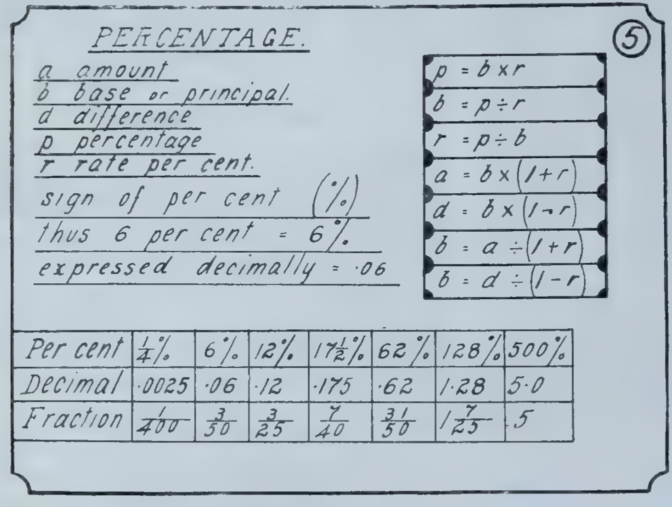
To change a fraction to a decimal annex ciphers to the numerator and divide by the denominator. Point off as many decimal places in the quotient as there are ciphers annexed.

To change a decimal to a fraction. Under the figures of the decimal, place 1 with as many ciphers to its right as there are decimal places in the decimal, and reduce this fraction to its lowest terms.

To change a decimal to a fraction having a given denominator, multiply the decimal by the given denominator. The integral part of the product will be the numerator of the fraction.

Percentage.

Percentage is the process of calculating by hundredths. The sign of percentage is %, and is read per cent.; thus, 7% reads seven per cent. The different elements used in percentage are:—base, rate per cent., percentage, amount and the difference. The base is the number on which the per cent. is computed; the rate is the number of hundredths of the base to be taken; the percentage is the portion of the base indicated by the rate; the amount is the sum of the base and the percentage, and the difference is the remainder obtained by subtracting the percentage from the base:—(see Chart 5).



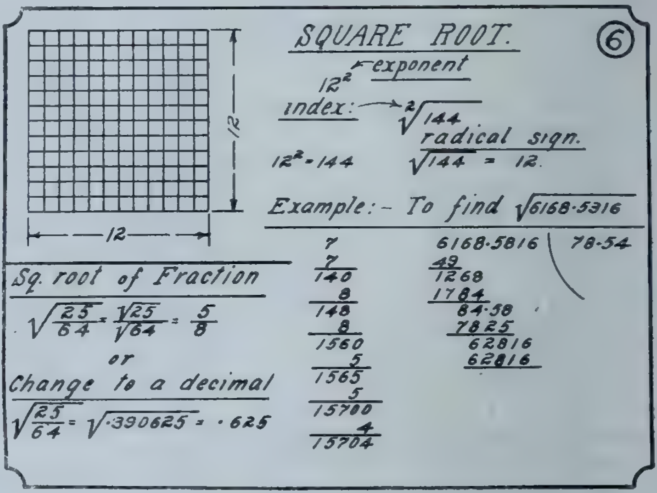
PERCENTAGE.

a amount
b base or principal.
d difference
p percentage
r rate per cent.
sign of per cent (%)
thus 6 per cent = 6%.
expressed decimally = ·06

$p = b \times r$
$b = p \div r$
$r = p \div b$
$a = b \times (1+r)$
$d = b \times (1-r)$
$b = a \div (1+r)$
$b = d \div (1-r)$

Per cent	$\frac{1}{4}$%	6%	12%	$17\frac{1}{2}$%	62%	128%	500%
Decimal	·0025	·06	·12	·175	·62	1·28	5·0
Fraction	$\frac{1}{400}$	$\frac{3}{50}$	$\frac{3}{25}$	$\frac{7}{40}$	$\frac{31}{50}$	$1\frac{7}{25}$	5

ARITHMETIC CHART 5.



SQUARE ROOT.

12^2 ← exponent

index: → $\sqrt[2]{144}$ radical sign.

$12^2 = 144$ $\sqrt{144} = 12.$

Example:– To find $\sqrt{6168{\cdot}5316}$

7	6168·5816	78·54
7	49	
140	1268	
8	1184	
148	84·58	
8	7825	
1560	62816	
5	62816	
1565		
5		
15700		
4		
15704		

Sq. root of Fraction

$$\sqrt{\frac{25}{64}} = \frac{\sqrt{25}}{\sqrt{64}} = \frac{5}{8}$$

or

Change to a decimal

$$\sqrt{\frac{25}{64}} = \sqrt{{\cdot}390625} = {\cdot}625$$

ARITHMETIC CHART 6.

Example:—The output of a certain factory was 275 cars a year; by the introduction of new machinery, the increase in production was 18%. What was the new output?

Here, the 275 is the base; the rate 18% expressed in hundreths is 18/100 or .18; the percentage of increase is the base × rate, or $275 \times .18 = 49.50$.

The amount or new output would be the base, 275 + the percentage or increase, 49.50; or, by direct formula, the amount=base × (1+rate), or new output $= 275 \times (1+.18) = 275 \times 1.18 = 324.50$.

Involution and Evolution.

This section which is much used and almost indispensable in the solution of many mathematical problems, although apparently quite difficult when first studied dissolves itself, like most others, into an application of the four elementary principles of arithmetic:—addition, subtraction, multiplication and division.

The product obtained by multiplying a number by itself is called a power of that number. This process is called involution. Example, $3 \times 3 = 9$, then 9 is the second power of 3, and the third power of $3 = 3 \times 3 \times 3 = 27$.

To show to what power a number is to be raised, a small figure called an exponent is placed to the right and a little above the number: thus, $4^2 = 4 \times 4 = 16$, and $12^3 = 12 \times 12 \times 12 = 1728$.

The number being raised to the required power is called a root of that power. To find any power of a number, multiply the number by itself as many times as there are units in the exponent.

Evolution is the reverse of involution, being the process of finding the root of a number which is considered as a power.

The square root of a number is that number which, when multiplied by itself, produces the number. Thus, 9 is the square root of 81, since $9 \times 9 = 81$.

The cube root of a number is that number which, when multiplied by itself three times produces the number. Thus, 4 is the cube root of 64, since $4 \times 4 \times 4 = 64$.

The radical sign √ when placed before a number, indicates that some root of the number is to be taken, and, to indicate what root is required, a small figure, called the index, is placed to the left and above the radical sign. Thus,

$\sqrt{16}$ denotes sq. root of 16.
$\sqrt[3]{343}$ denotes cube root of 343.
$\sqrt[4]{27.42}$ denotes fourth root of 27.42.

Square Root.

To extract the square root of a number, see Chart 6.

Example:—To find $\sqrt{121104}$.

Begin at the units place, and separate the number into periods of two figures each. Thus 12, 11, 04.

Find the greatest number whose square is contained in the first or left hand period; write this figure as the first figure in the root, also write it to the left of the given number. Thus,

3 12, 11, 04 3.

Multiply this number at the left by the first figure of the root, and subtract the result from the first period, then annex the second period to the remainder. Thus,

3	12, 11, 04	3
	9	
	——	
	311	

Add the first figure of the root to the number in the first column on the left, and annex a cipher to the result. This is the trial divisor. Divide the dividend by the trial divisor for the second figure in the root and add this figure to the trial divisor to form the complete divisor. Multiply the complete divisor by the second figure of the root, and subtract the result from the dividend. If this result be larger than the dividend, a smaller number must be used for the second figure of the root. Annex the third period to the last remainder for a new dividend. Add the second figure of the root to the complete divisor, and annex a cipher for a new trial divisor. Thus,

3	12, 11, 04	34
3	9	
—	—	
60	311	
4	256	
—	——	
64	5504	
4		
—		
680		

Continue in this manner to the last period.

3	12, 11, 04	348.
3	9	
—	—	
60	311	
4	256	
—	——	
64	5504	
4	5504	
——	——	
680		
8		
——		
688		

Then $\sqrt{121104} = 348$.

ASSOCIATION AND PERSONAL

A Monthly Record of Current Association News and of Individuals
Who Have Been More or Less Prominent in the Power Field.

Athol Davies, the stationary engineer who was badly burned when an explosion of natural gas occurred on Tuesday morning, February 24, and wrecked the boiler-room at the generating plant of the Chatham, Wallaceburg and Lake Erie Railway, Chatham, Ont., died at St. Joseph's Hospital on February 27. John Montague and William Roberts, firemen, who were also injured, are progressing favorably, and will recover.

Hamilton, No. 2, C.A.S.E.—On a recent evening, Hamilton, No. 2, C.A.S.E., accompanied by Executive President S. E. Cosford and Executive Vice-President A. W. Heath, journeyed to Brantford on a fraternal visit to Brantford, No. 4, C.A.S.E. They were met the station and escorted to the lodge room. An open session was held, with the Executive President, S. E. Cosford, in the chair. A very pleasant evening was spent by all, a varied programme of speeches and recitations being the feature. The Executive President urged upon all present to do their best towards increasing the membership of the Order. An invitation was extended to Brantford members to visit Hamilton at an early date, which was accepted. We have had several very good addresses lately by representatives of the Murphy stoker, and the Call Rotary Engine. The blackboard is in use every evening. Electricity forms a very prominent feature in our discussions, and the question box is being used to much advantage.

Chatham, No. 21, C.A.S.E. held an open meeting on Thursday, Feb. 19th, which was well attended, Bro. Joe. H. Stoliker, presiding. The meeting was held for the purpose of encouraging to the lodge room engineers who are not members, and to bring before them the work of the C.A.S.E. The evening was spent as follows: Bro. C. Kelley gave an address covering the development of the C.A.S.E. from its beginning in May, 1887, up to the present time. Bro. Ed. Grandboise read a paper on the use of indicator. Bro. William Condon read a paper on the selection of oils and lubrication. Bro. John Basley gave an address on behalf of the C.A.S.E. while a number of other short addresses were given along the same lines. Bro. Joe H. Stoliker took up some work on the blackboard which was interesting to all. The next open meeting will be held on March 19th. Good metings have been the rule all through the winter, and six applications for membership were received as a result of the above mentioned open meeting.

* * *

NEW C.A.S.E. LODGE AT MONTREAL.

THERE has long been a feeling among the leading stationary engineers of Montreal that there existed a very real need for an association, similar to those in other provinces, by means of which their interests could be looked after. There are already two such associations or societies in Montreal, but both are entirely French in character and sympathies. Hence it was quite clear that in the Dominion's commercial metropolis there was ample room for another society of engineers.

H. L. SACKETT,
President C.A.S.E. Lodge No. 1, Montreal.

This being the case, a number of prominent stationary engineers in the city got together and approached the executive council of the Canadian Association of Stationary Engineers with a request for a charter giving them power to form a Montreal lodge. This request was readily granted, and on February 27, Brother A. Kastella, executive secretary, went from Ottawa to Montreal to open the new lodge, henceforward to be known as Montreal Lodge No. 1, C.A.S.E.

As a start, twenty-five charter members were initiated, their names being as follows:—W. Brown, J. Carmichael, F. Cunnington, W. Fife, J. Forbes, W. Forbes, R. Gallimore, A. Hall, E. Holmes, — Hudson, W. J. Johnston, A. L. Jones, C. H. Lloyd, J. Mitchell, A. S. Parker, H. K. Paton, — Poleman, C. Ralph, H. L. Sackett, A. J. Smith, M. Smith, R. D. Smith, W. Smith, I. J. Tait, and S. Winter.

Brother Kastella also installed the officers previously elected by the lodge. These are:—Past president, C. H. Lloyd; president, H. L. Sackett; vice-president, R. D. Smith; treasurer, J. Mitchell; financial secretary, J. W. Johnston; recording secretary, A. L. Jones; conductor, W. Brown; doorkeeper, J. Carmichael.

The utmost enthusiasm is being shown by the members of the new lodge, and numerous applications for membership are being received. It is expected that fully twenty-five more members will be elected at the next meting.

The objects of the C.A.S.E. are set forth in the preamble to the constitution as follows:—

"This association shall at no time be used for the furtherance of strikes or in any way interfere between its members and their employers in regard to wages. It shall recognize the identity of interests between employer and employees, and shall not countenance any project or enterprise that will interfere with perfect harmony between them. Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the promotion of education, professional and mechanical knowledge."

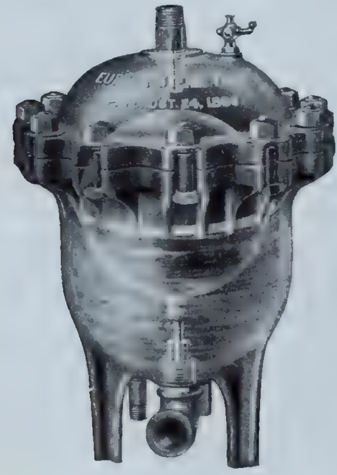
The twenty-five charter members of the new lodge represent some of the most important power plants in Montreal, and all are working hard to gather in other members and make Montreal Lodge No. 1 one of the most successful in the association.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

THE EUREKA STEAM TRAP.

THE manufacture of the Eureka steam trap has recently been taken over by the Racine Tool and Machine Co., Racine, Wis. As may be seen from the illustration, the trap is simple in construction, and is stated to be positive in action. The valve is controlled by a copper ball float, and the weight of this float, together with the steam pressure, keeps the outlet closed until such time as the buoyancy of the float overcomes both its own weight and the unbalanced pressure on top of the stem. The valve then immediately lifts wide open and the water is discharged; thereupon the float falls and again closes the valve. The valve is thus always wide open or entirely closed as the flow of condensation requires. During the time the trap is discharging, a vortex is created which causes the float to revolve, thereby automatically grinding the valve on its seat at each operation, thus keeping it tight and assisting the water seal to prevent leakage of steam. The valve seat is extended up into the vessel in order to protect it from damage from sediment which may collect in the bottom of the trap.


THE EUREKA STEAM TRAP.

An interesting feature claimed by the makers is that the valve opens and closes instantly. The float does not, as might be expected, rise gradually with the rise of the water; but is so adjusted that as soon as the latter reaches a certain level, and not till then, the valve is suddenly opened. It is claimed that this trap will elevate the water two feet for every pound of steam pressure available. It is made in two styles, one for low pressure service and the other for high pressure. The former is used for pressures from 4 to 50 pounds, while the high pressure type is intended for use from 50 to 175 pounds pressure.

The Foss & Hill Machinery Co., Montreal, are sales agents for this trap.

◆

AUTOMATIC CONDENSATION PUMP AND RECEIVER.

THE automatic condensation pump and receiver here illustrated is, as will be noted, a self-contained unit, therefore, easy of installation. It is only necessary to connect the return line to the tank, run a pipe from the discharge opening of the pump to the boiler and connect the electric wires from the starting switch on top of the bank to the nearest light socket.

AUTOMATIC CONDENSATION PUMP AND RECEIVER.

As the condensation flows from the return line into the tank, it raises a reinforced copper float, which is vented to the atmosphere, so that it will not be affected by the change of temperature in the condensation of water.

This float operates an electric switch that starts the motor and pump. The lowering of the float as the condensation water is pumped from the tank back to the boiler throws the switch out and stops the pump and motor.

The operation being automatic no attention is required aside from an occasional oiling of the pumps and motor. The suction of the pump is extended to the bottom of the tank so that practically all of the condensation water is returned at each operation. The receiving tank is small enough so that the condensation water is returned frequently, and is not cooled to any great extent.

Thomas & Smith, Inc., Chicago, are the makers of this apparatus.

◆

GEORGE WESTINGHOUSE DEAD.

GEORGE WESTINGHOUSE died suddenly on March 12, in New York. He was sixty-eight years of age and was perhaps best known as the inventor of the air brake which bears his name, and which revolutionized railroading. The airbrake which he invented is used thhroughout the civilized world, and in almost every part of the globe there are great plants which he founded.

He founded many manufacturing companies in the United States, Canada and abroad, the latter including plants at Hamilton, Ont., Canada, Manchester and London, England. In the Westinghouse industries some 50,000 persons are employed and the many Companies have a capitalization aggregating $200,000,000.

He was literally a horny-handed son of toil, for his hands were hardened and seared from much contact with tools and metal. Those who knew him best called him "the man who worked." He had to meet financial difficulties more than once after becoming famous as an inventor and manufacturer, but overcame them, and a few years ago his personal fortune was estimated at $50,000,000. His wife, whom he married in 1867, and one son, George Westinghouse, Jun., survive him.

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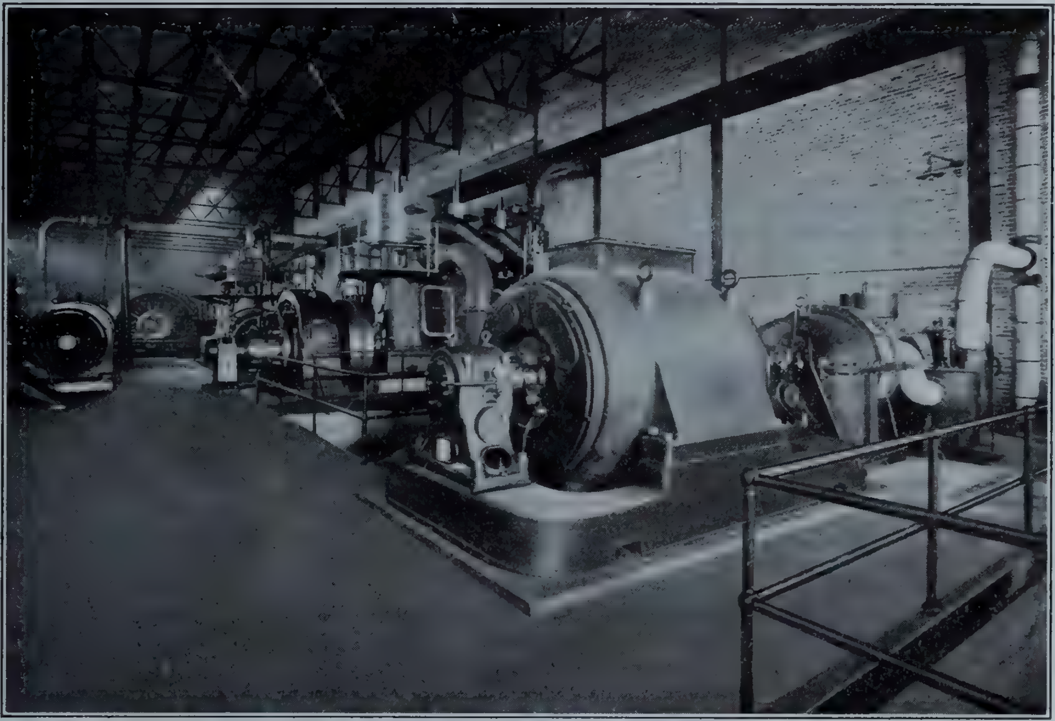


"EDMONTON POWER HOUSE" showing the following SIEMENS MACHINES:

2,000 K.W. TURBO-GENERATOR—in the foreground.
750 K.W. DIRECT CURRENT GENERATOR—behind the turbo-generator.
425 H.P. MOTOR—on the left.

"We are also installing a 4,000 K.W. turbo-generator, making a total of 9,500 H.P. supplied to the above Power House.

"We undertake the complete equipment of Power Plants of every description, and Transformer Stations up to and including 110,000 volts."

Siemens Company of Canada Limited

HEAD OFFICE:

Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

Harriston, Ont.—The large cold storage building of the William Davies Co. has been temporarily closed. It is announced that business will be abandoned at this plant until the arrival of hydro power.

Fort Francis, Ont.—The York Manufacturing Co., York, Pa., recently installed a 4-ton vertical, single-acting, belt-driven enclosed type refrigerating machine, and high pressure side complete, in the Fort Francis Hotel here.

Windsor, Ont.—The Central Ice & Cold Storage Co., Ltd., is asking the city of Windsor for the usual exemptions and not for free water to make ice. They want only such exemptions as are granted to any manufacturing concern. J. H. Green, manager.

Coquitlam, B.C.—The Coquitlam Ice Co., on Dewdney Trunk Road, contemplate extending their plant, and work is to commence immediately on a new ice house on the rear of the establishment. The added building will cost in the neighborhood of $400.

The Babcock & Wilcox Co., Ltd., Toronto, have received an order for four 300 h.p. boilers from the Canadian Kodak Co. for their new factory at Mount Dennis, Ont. They are also supplying a 150 h.p. boiler to the Moose Mountain Mines at Fellwood, Ont.

Ottawa, Ont.—City Engineer Currie has presented a report to the city council for an alternative scheme to the proposed water supply from Thirty-one Mile Lake. The new scheme provides for a mechanical filtration plant and reservoir, the estimated cost being $53,000.

Montreal, Que.—Two new 12-million gallon pumps are to be bought by the city at once, and other improvements are to be made to the pumping system which will cost $144,000. A report to that effect was submitted to the city council on March 4th by the Board of Control. The items in the report are: For a conduit to supply the new pumps, $25,000; two 2-million gallon pumps and boiler building, $85,000; two boilers, $24,000; and a new brick chimney and connections, $10,000; making a total of $144,000.

Windsor, Ont.—The new plant which the Central Ice & Cold Storage Co. will build, will be five stories high, of steel and concrete construction. The building will be 800 x 150 ft., and will have a storage capacity of 500,000 cub. ft. The estimated cost of buildings and equipment will be $150,000.

Northern Electric Co., Ltd.—The recently incorporated Northern Electric Co., Ltd., has taken over the Northern Electric & Mfg. Co. and Imperial Wire & Cable Co. The business previously carried on by the two latter concerns will be conducted by the newly-organized company without change in management.

Ottawa, Ont.—Sealed tenders addressed to the Secretary of the Department of the Interior, Ottawa, Ont., will be received up to noon, 6th April, 1914, for the supply of 13,500 lineal feet of 20-in. diameter lapwelded steel pipe, and 12,000 lineal feet of 6-in. diameter cast iron pipe for the water system at Banff, Alta. Specifications may be had from the Commissioner of Dominion Parks, Ottawa, Ont.

Montreal, Que. — Another step towards the completion of the city's new filtration plant at Point St. Charles, was taken on March 4, with the opening of tenders before the Board of Control, for contract No. 4, comprising pump house and other buildings for the plant. The tenders were referred to the chief engineer for report. The contractors and tenders were: F. J. Jago Co., alternative prices, $155,000 and $159,500; A. G. Loomis & Son, $174,000 and $170,000; Norman Macleod, $193,000, and $199,000.

Humboldt, Sask.—Sealed tenders will be received by the secretary-treasurer until 8 p.m., Wednesday, April 15, for the following works.—(A)—Labor laying water mains and sewers. (B)—Pump house and filter house. (C)—Furnishing material for and erecting water tower. (D)—Furnishing cast iron water pipes. (E)—Furnishing fire hydrants and valves. (F)—Furnishing and installing pressure filters. (G)—Furnishing and installing pumping machinery. (N)—Furnishing wood stave pipe. (O)—Laying wood stave pipe. (P)—Constructing ejector station. (S)—Furnishing sewer pipes. (X)—Constructing sewage disposal works. Plans and specifications may be seen at the office of the engineers, Toronto and Winnipeg, and at the town hall, Humboldt, on and after March 16th. Chipman & Power, engineers, Toronto.

Medicine Hat, Alta.—President Pearson of the Medicine Hat Pure Ice Co., and Mr. Davidson of the same concern, are completing arrangements with the city for a site for their ice plant. It is understood that the site has been secured and without doubt an agreement will be entered into at once. The plant will be one of the largest of its kind, and the firm are contemplating the building of a large skating rink and curling rink in addition to the ice making plant. It is their intention to have the plant completed in time for the summer ice trade.

◆

S. E. Cosford in Accident.—C.A.S.E. Executive President, S. E. Cosford met with an almost fatal injury through falling some 25 feet, while engaged repairing a motor. Contact with a cross bar in his fall, broke all of his ribs on one side, two of them piercing his lungs. His condition was more or less critical for a week, but latest advices state that he is progressing favorably towards recovery.

◆

Boiler Inspection Query.—C. M. McCabe, Totenham, Ont., wishes to know if the Ontario Government laws require all steam boilers, irrespective of size and pressure, to be inspected once a year, whether they have been actually in service or not during the period. The statutes of Alberta and Saskatchewan, he states, make the above inspection necessary.

KEEP YOUR EYE ON THE COAL PILE

If your coal bills are gradually increasing without a corresponding increase of power, there is a reason for it, and it is a safe bet that the increase is caused by scale in your boilers. And if you have scale, the logical thing for you to do is to order a LIBERTY TUBE CLEANER and stop the useless waste.

A LIBERTY CLEANER will pay for itself many times over, and there is no other investment you can make that will pay as large a dividend for the amount invested. Think it over.

We will send you a Liberty Cleaner on trial. If it fails to do your work *better* than any other make of Cleaner, you don't have to keep it.

Descriptive Catalogue on application.

Liberty Manufacturing Company
6904 Susquehanna Street PITTSBURGH, PA.
Canadian Representatives:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

"TWINS" EXCITE ADMIRATION

Because They Earn It

Think of a TWIN when you hear the word STRAINER

The installation of a Twin Strainer on your water supply line eliminates troubles, worry, waste of time and expense—because

It has two straining baskets—that may be cleaned alternately, thus permitting continuous operation.

It has but two valves—they are of the gate type and are always tight.

It gives a direct flow with minimum friction loss, insuring easy operation with no waste of energy.

In fact, a Twin Strainer is an insurance policy in active service.

Designed to protect and built to last.

Write for our bulletin.

THE TWIN STRAINER.

ELLIOTT COMPANY
6902 Susquehanna Street, PITTSBURGH, PA.
Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.
CANADIAN REPRESENTATIVES:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

Catalogues

Steam Pumps are dealt with in Catalogue No. 9 recently issued by the Smart-Turner Machine Co., Ltd., Hamilton, Ont. Several types are illustrated and a brief description given of each.

The DeKalb Ammonia Compressor is the subject of a catalogue sent to us by the Creamery Package Manufacturing Co., Chicago. The principal features embodied in the design of this compressor are illustrated and described in a comprehensive manner.

Westinghouse Portable Meters are dealt with at length in a new circular, 1,104, which the Canadian Westinghouse Co., Ltd., Hamilton, have recently issued. Several types are illustrated and described for both a.c. and d.c. current. Copies will be gladly sent to interested readers.

''Lagonda Cut-off Valves'' is the title of an attractive catalogue which has been issued by the Lagonda Mfg. Co., Springfield, O. The valves and other specialties manufactured by the company are illustrated and described fully, the illustrations including views of several installations. Copies of this catalogue may be had by writing.

The Canadian General Electric Co., Ltd., Toronto, are distributing No. A4185, which deals with single-phase induction motors, type K.S. A full description is given of these motors, and the illustrations show the details of construction. A diagram with table is included giving the principal dimensions and weight for each size.

Motor-Generator Sets, small types, M.C. and M.C.C., are dealt with in Bulletin No. A4190, recently received from the Canadian General Electric Co., Toronto. Illustrations are given of all the various parts of these machines, and the reading matter describes them in a full and comprehensive manner. The principal dimensions of each size are given on the last two pages of the bulletin.

Direct Current Generators, small belted type, are the subject of Bulletin A4188 issued by the Canadian General Electric Co., Ltd., Toronto. A complete description covering the constructional features of this type of generator is given, together with illustrations of the various parts of the machine. The bulletin concludes with a diagram and table giving the principal dimensions of each size.

The Vilter Mfg. Co., Milwaukee, Wis., have sent us a copy of bulletin No. 22A, entitled ''Chemistry of Raw Water Can Ice,'' written by John C. Sparks, B. Sc. This bulletin deals with the manufacture of ice, principally from a chemical standpoint, and contains some very interesting data on the subject. The bulletin is a reprint from a paper read before the American Society of Refrigerating Engineers, New York.

The Morse Chain Co., Ithaca, N.Y., has issued a pamphlet, No. 12, entitled the ''Morse Long-Service Chain Drives.'' The pamphlet consists of a number of short descriptions of typical ''Morse'' silent chain drives showing their durability and efficiency for long periods of time. Each installation is illustrated, and a summary is given of all the drives. The pamphlet concludes with particulars regarding the design and operation of the ''Morse'' chain.

The Canadian Westinghouse Co., Ltd., Hamilton, Ont., are distributing a circular No. 1156, dealing with types ''S'' and ''R'' direct-current generators. The description of the generators is equivalent to a specification, as each part is dealt with in detail and illustrated. Other illustrations cover steam engine-driven and motor-generator sets. One section of the circular is devoted to field rheostats, which are also illustrated and described in detail.

Hydraulic Valves and Fittings are the subjects dealt with in catalogue No. 43, issued by the Hydraulic Press Mfg. Co., Mount Gilead, O. Illustrations are given of an extensive line of hydraulic appliances including operating valves of several types, safety or relief valves, accumulator controls, speed governors, etc. The reading matter is very descriptive and includes several tables on dimensions and areas of hydraulic pipes and other useful information.

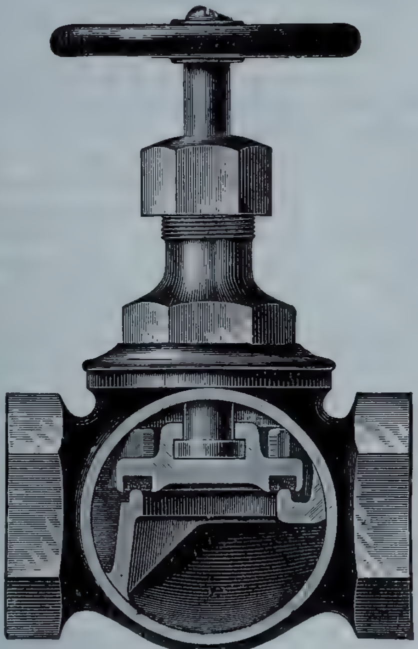
The Canadian General Electric Co., Ltd., Toronto, have issued Bulletin No. A-4064 describing their mill type motors. The constructional features of these motors are illustrated and described at length, each part being treated separately. These motors are specially adapted for working in steel plants and similar service, and are made in various forms, according to the work required of them. The bulletin contains diagrams and tables giving the principal dimensions for each type.

Power Transmitting Machinery is the title of Catalogue No. 35 which we have received from the Canadian Bond Hanger and Coupling Co., Alexandria, Ont. This is a new catalogue and contains particulars of a full line of transmission machinery made by the company. Each type of equipment is illustrated and tables are included giving the principal dimensions, price, and code word of each size. One of the features of the catalogue is the ''Grundy'' flexible insulated coupling, designed for connecting motors to pumps, fans, etc. The catalogue contains an index and telegraph code. Copies may be obtained from the manufacturers or from the Dominion Machinery Co., Toronto, their the Canadian office, 14 Alexander street, Toronto.

The Terry Steam Turbine Co., Hartford, Conn., have sent us a copy of Bulletin No. 17, dealing with the ''Terry'' return-flow steam turbine. The design of this type of condensing turbine is a combination of a multi-velocity stage element for the high pressure end, with a series of multi-pressure stage elements in the low pressure end. The principal features embodied in the design of this turbine are described at length, and the claims for the return-flow principle are dealt with in a comprehensive manner. The illustrations show exterior and interior views of the turbine, while a condensed specification covers the principal constructional features. Copies of this bulletin may be had by writing the company.

Bulletin No. 57 ''The Phenix Sight Flow Indicator,'' recently issued by the Richardson-Phenix Co., of Milwaukee, Wisconsin, illustrates and describes how this unique little device can be inserted in any pipe line carrying a liquid, such as water lines of water cooled transformers and the supply pipes of water jackets of gas engines and air compressors, and how it shows at glance or indicates electrically by lighting a lamp or ringing a bell when the flow of liquid is interrupted. Several recent improvements in the Sight Flow Indicator are also described, showing how it is now possible to adjust the indicator so that it will give an alarm before the liquid stops flowing entirely, that is, when it drops to some predetermined minimum. This improvement has made it especially suitable for use on water-cooled transformers. Copies of the bulletin may be had by addressing the company as above.

Data Book on Silent Chain Drives.—The Link-Belt Company, Chicago, Ill., have published an engineering data book which is designed to enable users of power to select the correct silent chain drives for their work and determine exact costs from list prices shown in the book. eBsides giving much information on silent chain driving in simple and compact form, Data Book No. 125 describes many uses of silent chain for the efficient transmission of power, and gives specific reasons and illustrations showing application in a large variety of uses. Link-belt silent chain consists of a series of links connected by joints, which consist of segmental case-hardened bushings and case-hardened steel



Your Valves play a most important part in your Power Plant Equipment.

FAIRBANKS VALVES

should be used on all your high-pressure lines.

Tested under the most severe conditions, their great durability and strength enable them to give the greatest service.

High-class workmanship, and improved design, by Valve Experts, render them absolutely dependable at all times.

The Fairbanks Renewable Disc

the principal feature of Fairbanks Valves, owing to its composition of long-fibred Asbestos and rubber, with a special binding process, is long lived, unbreakable, tough, yet sufficiently soft to cushion perfectly with the valve seat. The RAISED ROUND SEAT is practically self-cleaning, its shape preventing the lodging of foreign substances which might injure or destroy the seat.

FAIRBANKS DISCS are easily renewed; simply remove the valve bonnet and slip a new disc upon the end of the spindle.

Fairbanks Valves are fully guaranteed, and regular weight valves are tested to 300 lbs. hydrostatic pressure.

Specify these valves for all your high-pressure lines, and be certain of getting the highest valve efficiency.

We can supply the demand for packings for any purpose. All Fairbanks Valves are packed with PALMETTO twist packing. You will save a lot of trouble with your valves if you do likewise. You know then that they will remain tight.

The Canadian Fairbanks-Morse Co., Limited

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO HAMILTON FORT WILLIAM
WINNIPEG SASKATOON CALGARY EDMONTON REGINA VANCOUVER VICTORIA

Canada's Departmental House for Mechanical Goods

pins. The chain, it is claimed, is as flexible as a leather belt, as positive as a gear, and its rated efficiency 98.2 per cent. on actual test. Over 200,000 installations, we understand, were drawn upon for the information contained in this data book. Copties of the book, which consists of 112 pages, bound in flexible red cover, can be obtained by addressing the Link-Belt Company, 39th Street and Stewart Avenue, Chicago.

The Canadian General Electric Co., Toronto, have issued bulletin No. A4185 dealing with single-phase induction motors, type KS. A full description is given of this motor with detailed illustrations. One page shows a diagram of the motor with a table giving the principal dimensions and weights for the different sizes.

The Johnson Temperature Regulating Co., of Canada, Toronto, have issued two pamphlets dealing with the "Johnson" system of temperature and humidity regulation. The system is described in detail, as are also the thermostats and other equipment installed in the system for various services. The illustrations include diagrams of systems, views, of thermostats, diaphragm and reducing valves, also of numerous buildings equipped with the "Johnson" system.

Boylston Steam Specialties are dealt with fully in Catalogue No. 10 which we have received from the Boylston Specialty Co., Chicago. The apparatus listed covers a full line of fittings for steam heating systems, such as valves, regulators, traps, etc. Each type of fitting is illustrated and described, while several pages are devoted to useful information covering heating systems and properties of steam. An interesting piping lay-out is included showing the location in the system of the various fittings listed.

Peebles Alternating Current Motors is the title of a pamphlet No. 22A recently issued by Bruce Peebles & Co., Ltd., Edinburgh, Scotland. The pamphlet is divided into two parts, one dealing with open type machines and the other with a self-contained type, both types being polyphase induction motors in large sizes. A general specification is included, while illustrations give a general idea of the design. In addition, there are a number of tables giving the principal dimensions, weights, H.P. and other data covering the various sizes. The pamphlet concludes with a list of customers and a list of foreign and colonial agents.

◆

F. Ross Newman, resident manager in Toronto of the Canadian Fairbanks-Morse Co., Ltd., has returned from Europe, having been away about six weeks.

Book Reviews

The Canadian Peat Society, Ottawa, have published their quarterly journal devoted to the peat industry and its advancement. The journal contains articles on peat moss, Canada's peat industry, the "Moore" gas producer, etc., also editorial comments on various matters relating to the peat industry, by-products obtained, and possibilities for development. The journal contains a number of illustrations of operations at Alfred, Ont.

List of Boiler Manufacturers.—The Supplymens' Association of the American Boiler Manufacturers' Asociation announce the completion of their list of boiler, tank and stack manufacturers of the United States and Canada, which is compiled in neat booklet form and contains names and addresses of something over 900 manufacturers. These books are offered to interested parties, such as tool and material manufacturers for the sum of three dollars ($3.00) per copy. Address, F. B. Slocum, Secy., C|o. The Continental Iron Works, West and Calyer Sts., Brooklyn, N.Y.

How to Build Up Furnace Efficiency, by Jos. W. Hays, combustion engineer, 126 pages, several illustrations and diagrams. Published by Jos. W. Hays, Chicago, Ill. Price, $1.00 post free. This is the seventh edition, revised and enlarged, of a handy little publication devoted to the subject of fuel combustion. It has been written with the idea of showing engineers and superintendents how a reduction in coal consumption can be accomplished in a practical manner. The subject is treated in a scientific, yet at the same time, in a thoroughly practical manner. The reader's attention is drawn to the waste of fuel, common in many power plants, a table on page 7 giving the heat losses in detail, from the coal, at the mine, to the heat delivered at the machine. The book is divided into practically five sections, which may be classified as follows: Why fuel is wasted; how fuel is wasted; how to spot fuel wastes; how to stop fuel wastes, and how to keep fuel wastes stopped. The subject in each section is dealt with fully and is accompanied by diagrams, views of apparatus, etc.

Condensed Catalogues of Mechanical Equipment have been published by the American Society of Mechanical Engineers, New York. This is the third annual (1913) volume of what is really a desk reference book of mechanical equipment, containing, as it does, 330 pages of condensed catalogue material. The purpose of this volume is to present in a concise form such facts concerning distinctive features, sizes, capacities, and special adaptations of mechanical equipment as are likely to be required for purposes of preliminary reference by engineers, superintendents, managers, etc. Practically all the important firms in the United States making power plant, machine shop and contractors' equipment, are represented in this book, one or more pages being devoted to each company for illustrating their principal products. The data is taken from the various manufacturers' catalogues and is arranged in catalogue form in a condensed manner. The arrangement makes it possible to use the volume as a reference book, as further information can be obtained from the usual sources. Both page and classified indexes are included in this book, which is bound in a substantial manner. The illustrations are good and the reading matter well arranged.

Elementary Manual of the Steam Engine, by Ernest V. Lallier, 250 pages, 7¾ x 5 in. 102 illustrations and diagrams. Published by the D. Van Nostrand Company, New York. Price, $2.00 net. This book, as the title indicates, is an elementary manual and is written primarily for students of steam engineering and young men engaged in the actual operation of steam plants. The author's main endeavor has been to present in a thoroughly practical and elementary manner, the use of steam, and give data relative to the operation of steam plants. The first chapter begins with a description of the reciprocating engine and its various parts and its method of operation. A chapter is devoted to the governor feature. Engine horse power is treated briefly in one chapter, but is discussed further in a chapter on the indicator. The chapters on steam and its exhaustive working are comprehensive and will be readily understood. A separate chapter has, however, been devoted to heat, this subject being treated independently of steam. Boilers, water and fire tube, are described at length, 42 pages being devoted to this section, which includes also a chapter on boiler calculations. Steam turbines are described briefly in the chapter on rotary engines, while 28 pages are devoted to a description of internal combustion engines. Other subjects dealt with include Corliss engines, pumps, pipes and fittings, while the last chapter is devoted to lubrication. At the end of each chapter is a series of questions which help to bring out the chief points of the subject under discussion and are a useful adjunct to a work of this description. The book is printed in clear type and bound in serviceable covers. It should be very helpful to those who are beginning to study the many problems associated with steam engine operation, as it is written in a manner so as to be readily understood.

Boiler Preservative

acts on the iron—not on the water. It is a boiler treatment in a class by itself.

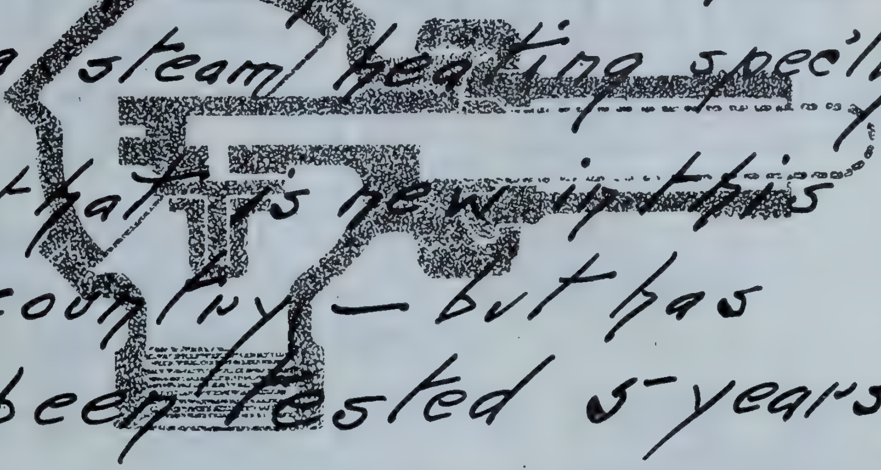
Water treatments are only partially successful, because the scale-forming sediment in water changes with seasons, climates and localities.

"MAGIC" removes scale and oil first, and then prevents scale forming. It stops pitting, corrosion and minor leaks.

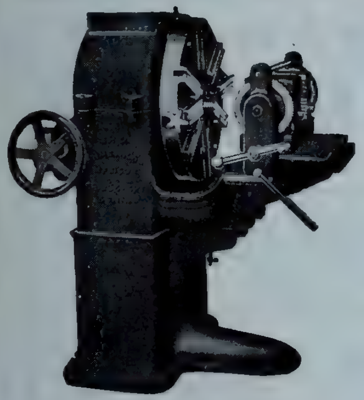
"MAGIC" saves the boiler and much labor.

A trial will convince you—write us.

Canada Supply & Contracting Co., Limited
220 King St. W., Toronto, Ont.



This space will discuss a steam heating spec'lty that is new in this country—but has been tested 5 years.



No. 3 PIPE MACHINE
THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES
A Very Desirable Machine for
PLUMBERS and STEAM FITTERS
Manufactured by
THE ARMSTRONG MFG. CO.
298 KNOWLTON ST.
BRIDGEPORT, CONN.
Write for Catalog
NEW YORK CHICAGO

Modern requirements

as to accuracy of thread, ease of manipulation, and regardless of design—behooves you to investigate pretty carefully when buying pipe-threading equipment.

All these and many other attributes, you will find when you look into the merits of the **Premier** die-stock, because it is the simplest narrow-die die-stock on the market.

The Premier has no loose parts to get lost; no lead screw and nut. It is entirely automatic—the patented offset die being responsible for its easy-working and quick throw-out at the end of the thread.

Send for descriptive literature.

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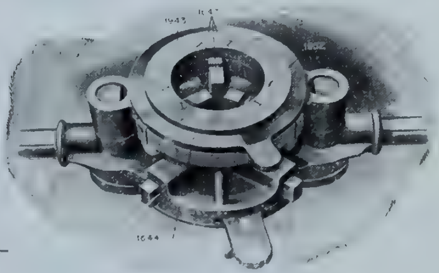


THE CANADIAN TURBINE WATER WHEEL
CONSERVE THE WATER POWERS
TRADE MARK.

Chas. Barber & Sons
Meaford : Ontario

WATER POWER EQUIPMENT ONLY

Write for Catalogue

Ideas at 2 Cents Each

¶ An idea that's worth anything at all to a Power Plant man is worth more than two cents.

¶ It might be worth hundreds of dollars.

¶ Every issue of "THE POWER HOUSE" is full of practical, helpful ideas. You ought to be able to sift out four each month that would prove of some use to you. Put a value of two cents on each and your subscription has been paid.

¶ You cannot afford to miss even one issue—you might miss the idea that would be worth hundreds of dollars.

¶ The date on the label of your "POWER HOUSE" wrapper shows when your subscription expires. One dollar will renew it for a year.

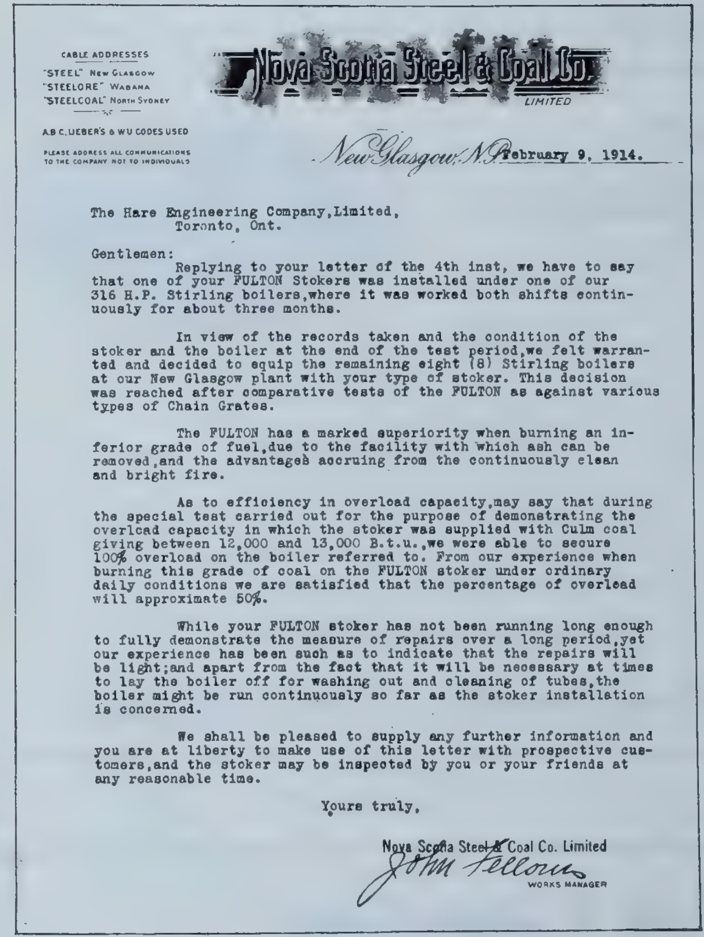
Don't put off Renewing—Do it to-day
Neglect blew up the Boiler

FULTON WATER-COOLED MECHANICAL STOKERS

—WIN OUT—

In a Three Months' Competitive Test Against Three Makes of Chain Grates and one Underfeed, in the Plant of

THE NOVA SCOTIA STEEL & COAL CO., LTD.



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"STEELORE" Wabana
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A.B C. LIEBER'S & W U CODES USED

PLEASE ADDRESS ALL COMMUNICATIONS TO THE COMPANY NOT TO INDIVIDUALS

Nova Scotia Steel & Coal Co.
LIMITED

New Glasgow, N.S. February 9, 1914.

The Hare Engineering Company, Limited,
Toronto, Ont.

Gentlemen:

Replying to your letter of the 4th inst, we have to say that one of your FULTON Stokers was installed under one of our 316 H.P. Stirling boilers, where it was worked both shifts continuously for about three months.

In view of the records taken and the condition of the stoker and the boiler at the end of the test period, we felt warranted and decided to equip the remaining eight (8) Stirling boilers at our New Glasgow plant with your type of stoker. This decision was reached after comparative tests of the FULTON as against various types of Chain Grates.

The FULTON has a marked superiority when burning an inferior grade of fuel, due to the facility with which ash can be removed, and the advantages accruing from the continuously clean and bright fire.

As to efficiency in overload capacity, may say that during the special test carried out for the purpose of demonstrating the overload capacity in which the stoker was supplied with Culm coal giving between 12,000 and 13,000 B.t.u., we were able to secure 100% overload on the boiler referred to. From our experience when burning this grade of coal on the FULTON stoker under ordinary daily conditions we are satisfied that the percentage of overload will approximate 50%.

While your FULTON stoker has not been running long enough to fully demonstrate the measure of repairs over a long period, yet our experience has been such as to indicate that the repairs will be light; and apart from the fact that it will be necessary at times to lay the boiler off for washing out and cleaning of tubes, the boiler might be run continuously so far as the stoker installation is concerned.

We shall be pleased to supply any further information and you are at liberty to make use of this letter with prospective customers, and the stoker may be inspected by you or your friends at any reasonable time.

Yours truly,

Nova Scotia Steel & Coal Co. Limited
John Fellows
WORKS MANAGER

With the result that we received a

REPEAT ORDER FOR

8—316 H. P. Stokers or

2,528 H. P.

READ WHAT THEY SAY

CANADA WINS over ENGLAND, SCOTLAND and UNITED STATES

No Sifting of Coal.
No Coke in the Ash.
100% Overload when required.
75% Efficiency.
Burns any grade Coal or Lignite, caking or non-caking, good or bad.

Repairs for TWO Years FREE

Let us figure on your requirements.

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IN STOKER DESIGN

Manufactured in Canada by

THE HARE ENGINEERING COMPANY
LIMITED

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Slightly Used Power Equipment

Westinghouse 175 k.w. Generator, 220 volts.

Ames Engine, 19x16, 225 revolutions, with switchboard and all connections.

Slide Valve Engine, complete (high speed), 10-inch cylinder, 12-inch stroke, with **Cocrane Feed Water Heater** and **Purifier** No. 23, and 5 ½ x 3 ½ x 7 **Boiler Feed Pump** (Darling Bros.).

Buckeye Boiler, 100 h.p.

All in first-class condition.

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Cheap 75 H.P. Corliss Engine, Boiler, Belts, Shafts, Pulleys, Hangers, Centrifugal Extractor, Large Tubs, Paddle Wheels, Fleshing Beams for Tanners.

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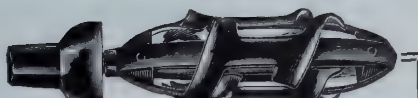

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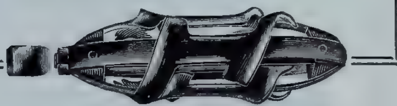

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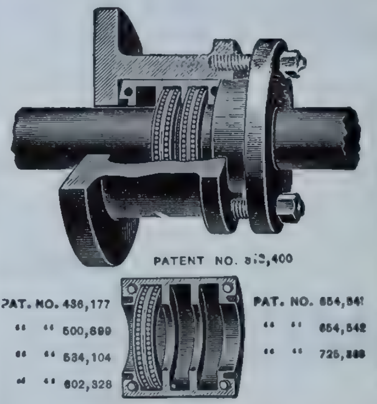

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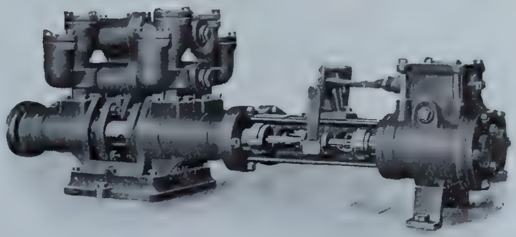

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Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.
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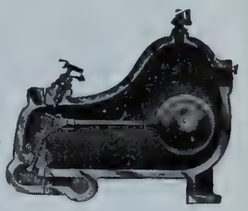

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The L. S. Starrett Co.
World's Greatest Toolmakers
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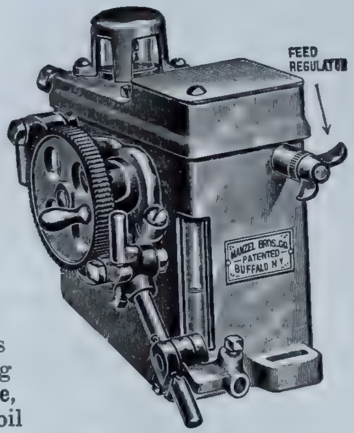
Don't lubricate the floor.



Saturating everything with oil, for ten feet around your engine, won't help things any. Lubricating the floor won't reduce cylinder friction. Besides which, it is very expensive—good oil costs money.

The **Manzel Sight Feed Oil Pump**, because it delivers a definite and unvarying amount of oil **per stroke**, because it puts that oil where it is required, because it doesn't lubricate the floor as well as the engine—reduces cylinder lubrication to a minimum, and cuts your oil bills anything from 30% to 60%.

And the proof is our 30 days' free trial offer.

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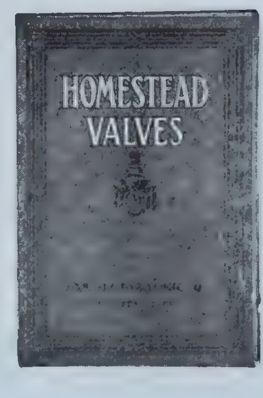

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Nasty, hot, uncomfortable work, too. But it's your duty, and, like a good engineer, you put duty ahead of personal likes and dislikes.

Just a moment, though! You want to try **Walker's Electric Boiler Compound** in your feed water. It will cut out all the scale, keep your boilers clean as can be, and stop your having to do any scurfing whatever.

And mind you, it won't injure them in the slightest nor interfere with the pumps in any way.

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That's a pretty fair offer, isn't it?

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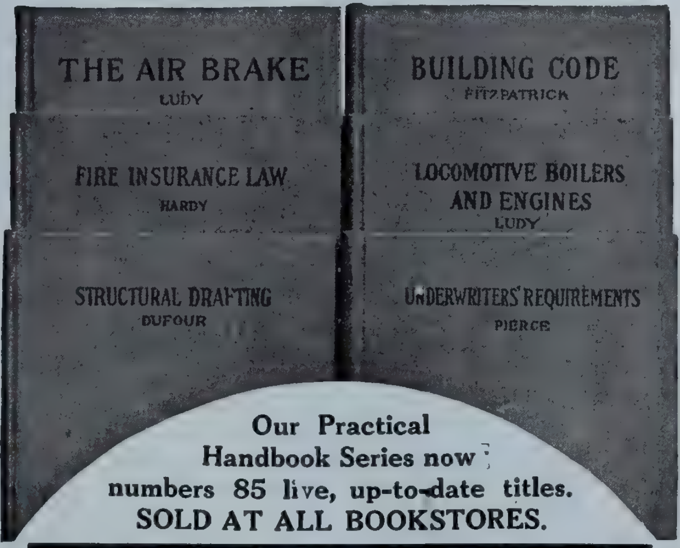

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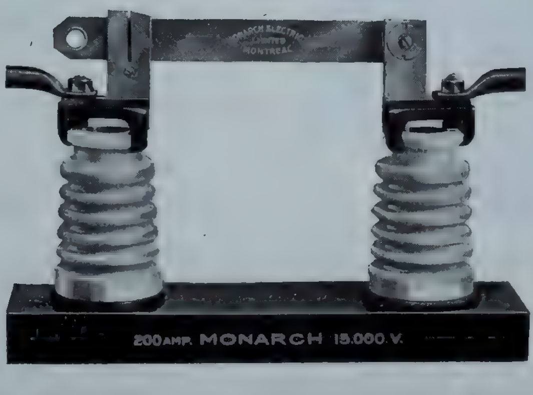

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You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

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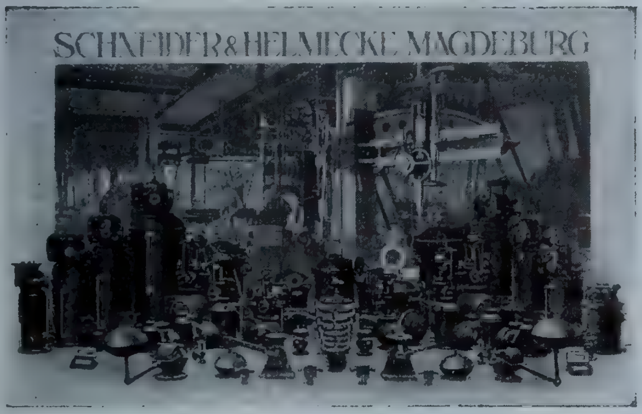

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SCREW-VALVE STEAM TRAPS.

RETURN STEAM TRAPS
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for Draining the Cylinders of Steam Engines.

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DUPLEX-DRAFT INDICATOR
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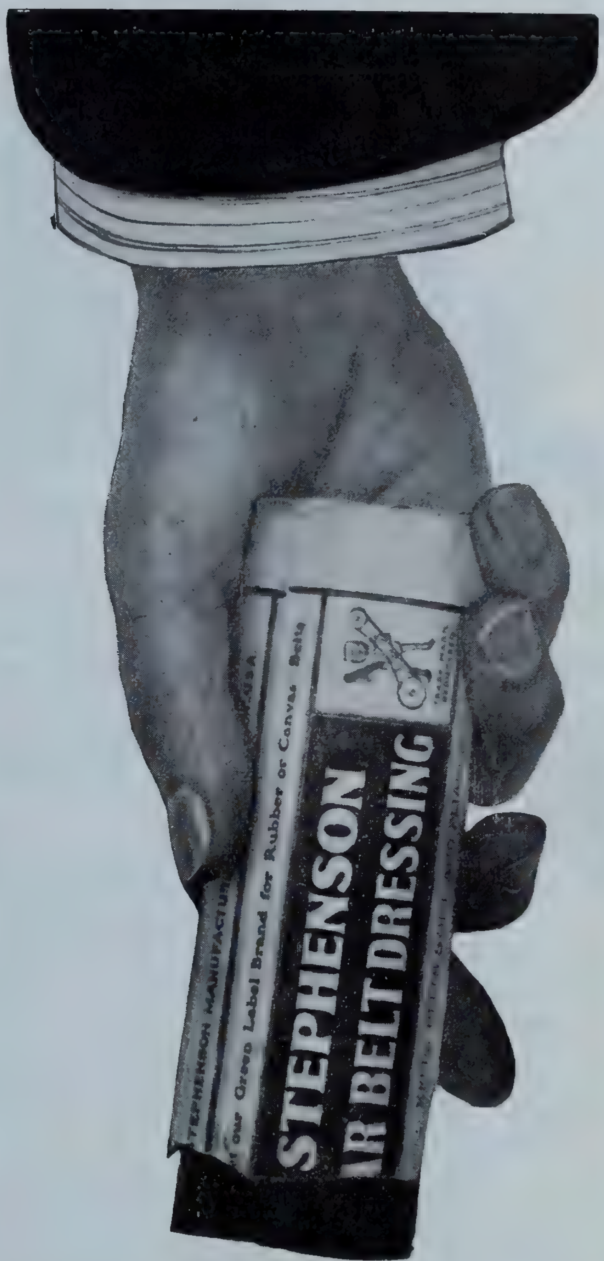

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Write for this sample—try it and see why.

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"B.&W." PATENT WATER TUBE STEAM BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

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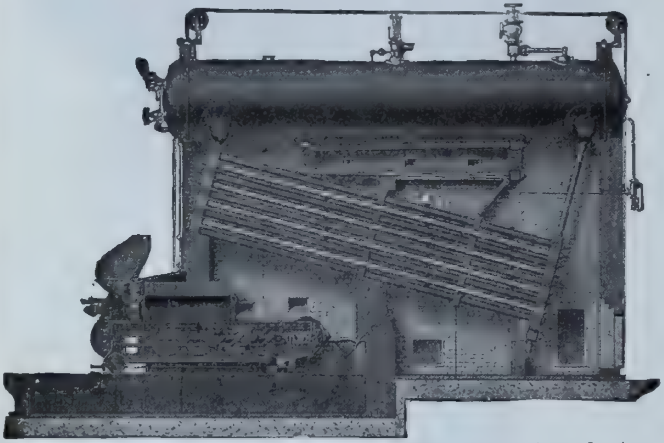

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FEED WATER IMPURITIES slip into your boilers unobserved like the proverbial lamb—and become a "roaring lion" of destruction.

The Problem with every steam power plant operator is, how **best** to get rid of these fuel-wasting, power-killing, boiler-destroying elements.

Now you wouldn't go *lion hunting* with a mouse trap, a fish net, a shot gun or a brass cannon—these weapons are all right for their purpose, but *no good for lions!*

R You would carefully select your weapons for the particular kind of game you sought to kill—fighting materials of proven efficiency!

R Now, how can you select weapons of proven efficiency to fight feed-water elements that cause Scale, Corrosion, Pitting, Foaming, Priming, etc., in your boilers until you have determined exactly what those elements are?

R Feed waters show a surprisingly wide range of variation in analysis—boiler plant conditions also vary—no two problems are ever exactly alike. There are many different kinds of scale, and many different chemical constituents of water that will cause corrosion and other boiler troubles. And there's a right re-agent for every one of these destructive elements and a right way to use it under every condition.

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R Nor can any substance by "mechanical action" hope to cope efficiently with distinctly chemical conditions. DEARBORN WATER TREATMENT is the logical way, the proven way, the one unfailingly dependable way out of your feed water troubles—

R Because—by expert chemical analysis and report, at our own invitation and expense, it first determines the exact conditions, with scientific accuracy, and then prescribes the right re-agents, carefully compounded in exactly right proportions, to meet those conditions.

R This is our chosen field of service—we were the pioneers in it and are masters of it; our laboratory and manufacturing equipment stands unique in extent and modern efficiency. Thousands of power plant operators in every civilized nation, attest the Integrity, Efficiency and Economy of Dearborn Water Treatment. Just why do you hesitate?

Send a one-gallon Sample, in clean container, of the water in exact condition as it enters the boiler—(after passing the heater if one is in use)—state source of supply, well, lake or river, and whether water has been treated by any method.

Dearborn Chemical Co. of Canada, Limited

TORONTO, CANADA

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Bearings.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Belt Cement.
Graton & Knight Mfg. Co., Worcester, Mass.
Belt Dressing.
British Pac. Sup. Co., Victoria, B.C.
Cling Surface Co., Buffalo.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.
Stephenson Mfg. Co., Albany, N.Y.
Graton & Knight Mfg. Co., Worcester, Mass.
Belt Tighteners.
Waterous Engine Wks. Co., Brantford
Belt Pulleys.
American Pulley Co., Philadelphia.
Belting, Camel Hair.
F. Reddaway & Co., Montreal.
Belting, Stitched Cotton Duck.
F. H. Andrews & Son, Quebec.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Dominion Belting Co., Hamilton, Ont
Belting, Leather.
F. H. Andrews & Son, Quebec.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
D. K. McLaren, Ltd., Montreal.
Graton & Knight Mfg. Co., Worcester, Mass.
Belting, Rubber.
F. H. Andrews & Son, Quebec.
Jeffrey Manufacturing Co., Columbus, Pa.
Quaker City Rub. Co., Philadelphia.
Beltings, all kinds.
Reddaway & Co., F., Montreal.
Belting, Scandinavia.
Federal Engineering Co., Toronto.
Bending, Pipe.
National Pipe Bending Co., New Haven, Conn.
Bins, Coal, Coke and Ore.
Jeffrey Manufacturing Co., Columbus.
Blocks, Lifting.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Blowers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Escher, Wyss & Co., Montreal.
Hare Eng. Co., Toronto.
Theodore Kipp Co., Winnipeg.
Boiler Compounds.
Can. Supply & Contracting Co., Toronto.
Can. Oil Companies, Ltd., Toronto.
Commercial Oil Co., Hamilton.
Perolin Co. of Canada, Toronto.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dearborn Chemical Co. of Canada, Toronto.
Electric Boiler Compound Co., Guelph, Ont.
C. C. Snowdon, Calgary.
Boiler Compound Feeders
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Can. Morehead Mfg. Co., Woodstock,
Boiler Feed Pumps.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Hare Eng. Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Nobis Engineering Co., Toronto.
Peacock Bros., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Boiler Feed Regulators.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Hare Eng. Co., Toronto.
Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Boiler Mountings.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
Boiler Tube Cleaners.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
S. I. Thomas, Toronto.
Vulcan Tube Cleaning Systems, Ltd., Montreal.
Boilers, Horizontal, Return, Tubular and Watertube.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Engineering Works of Canada, Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.,
Hamilton Co., Wm., Peterborough,
Jenckes Machine Co., Sherbrooke, Que
Jones Underfeed Stoker Co., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Polson Iron Works, Toronto.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Wks. Co., Brantford
Boilers, Marine, Locomotive and Vertical.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Can. Allis-Chalmers, Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Polson Iron Works, Toronto.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Wks. Co., Brantford
Brine Coolers.
Frick Co., Waynesboro, Franklin Co., Pa.
Brine Tanks.
Frick Co., Waynesboro, Franklin Co., Pa.
Cables, Aerial and Underground.
Eugene F. Phillips Electrical Works, Ltd., Montreal.
Cans, Oily Waste.
Jas. Morrison Brass Mfg. Co., Toronto.
Car Wheels.
American Pulley Co., Philadelphia.
Carbon Brushes.
Rougier Freres, Montreal.
Lunkenheimer Co., Cincinnati, O.
Carbon Paint.
Commercial Oil Co., Hamilton.
Carriers.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cast Iron Fittings.
Lunkenheimer Co., Cincinnati, O.
Cast Plate Track
Orenstein-Arthur Koppel Co., Pittsburg.
Castings, Brass and Iron.
Lunkenheimer Co., Cincinnati, O.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Cement, Fireproof.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Cement Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Chain Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Charging Cars
Orenstein-Arthur Koppel Co., Pittsburg.
Chemicals.
Dearborn Chemical Co., Chicago.
C. C. Snowdon, Calgary.
Circuit-Breakers.
Engineering Works of Canada, Ltd., Montreal.
Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Siemens Co. of Canada, Ltd. Montreal.
Coal.
Ohio & Michigan Coal Co., Detroit,
Clutches.
Elmira Machinery and Transmission Co., Elmira.
Waterous Engine Wks. Co., Brantford
Coal and Ash Conveyors.
Babcock & Wilcox, Montreal.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Hare Eng. Co., Toronto.
Jeffrey Mfg. Co., Columbus, O.
Geo. H. Tod, Toronto.
Theodore Kipp Co., Winnipeg.
Coal Handling Machinery.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
Coils.
Frick Co., Waynesboro, Franklin Co., Pa.
Collars.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Cold Storage Insulation.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Robinson Bros. Cork Co., Toronto.
Kent Co., Montreal.
Condensers.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John McDougall Caledonian Iron Wks, Montreal.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford
Arctic Ice Machine Co., Canton, Ohio.
Condensers, Ammonia and Steam.
Frick Co., Waynesboro, Franklin Co. Pa.
Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.
Condensation Receiver.
G. M. Davis Regulator Co., Chicago.
Conduits.
E. Leonard & Sons, London, Ont.
Can. H. W. Johns-Manville Co., Toronto.
Consulting Engineers.
Bayfield & Archibald, Vancouver, B.C
Chas. Bishop, M.I.C.S.A., Montreal.
de Gaspe Beaubien, Montreal.
John T. Farmer, Montreal.
Fetherstonhaugh & Co., Montreal.
Walter J. Francis, Montreal.
Jacobs & Davies, Inc., Montreal.
Pratt & Ross, Toronto.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Surveyor & Frigon, Montreal.
A. V. Tracy-Gould, Montreal.
Contractors, Structural Steel.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Conveyor Machinery.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Jeffrey Manufacturing Co., Columbus.
Geo. H. Tod, Toronto.
Waterous Engine Wks. Co., Brantford
Cooler Doors.
Jones Cold Store Door Co., Hagerstown, Md.
Cork Insert Pulleys.
American Pulley Co., Philadelphia.
Cork Insulation.
Can. H. W. Johns-Manville Co., Toronto.
Kent Co., Montreal.
Robinson Bros. Cork Co., Toronto.
Cork Tiling.
Robinson Bros. Cork Co., Toronto.
Cotton Hose.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia.
Couplings.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Jeffrey Manufacturing Co., Columbus.
Cranes, All Kinds.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cranes, Electric.
Babcock & Wilcox, Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Cranes, Hand Power.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cranes, Overhead Travelling.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cranes, Post Jib.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cranes, Swing Jib.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Cranes, Wall.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Crank and Crosshead Pin Oilers
Lunkenheimer Co., Cincinnati, O.
Crushing Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Cut Outs
Duncan Electrical Co., Montreal.
Damper Regulators.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.

Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Geo. H. Tod, Toronto.

Detector Phones.
The Maihak Indicator Agency, Montreal.

Die Stocks.
Oster Mfg. Co., Cleveland, O.

Distilling Apparatus.
Frick Co., Waynesboro, Franklin Co., Pa.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Double Pipe Condensers.
Frick Co., Waynesboro, Franklin Co.,

Dry Cleaners Systems.
S. F. Bowser & Co., Inc., Toronto.

Drying Machinery.
Can. Fairbanks-Morse Co., Montreal.

Dynamos.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Economizers.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.
Siemens Co. of Canada, Ltd. Montreal.
Theodore Kipp Co., Winnipeg.

Electrical Accessories and Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
Duncan Electrical Co., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Theodore Kipp Co., Winnipeg.
Monarch Electric Co., St. Lambert, Que.
Northern Electric & Mfg. Co., Limited Montreal.

Electrical Repairs.
Siemens Co. of Canada, Ltd. Montreal.

Electrical Supplies
Duncan Electrical Co., Montreal.

Elevators.
Engineering Works of Canada, Ltd., Montreal.
John McDougall Caledonian Iron Wks, Montreal.

Elevating Machinery.
Can. Fairbanks-Morse Co., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

Engines, Automatic and Drop Valve.
Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
W. H. Allen Son & Co., Bedford, Eng.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
John Robson (Shipley) Ltd., Shipley, Eng.
Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Engineering Works of Canada, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
International Engineering Works, Ltd., Amherst, N. S.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
W. H. Allen Son & Co., Bedford, Eng.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Kerr Engine Co., Walkerville.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brant-

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.

Exhaust Fans.
W. H. Allen Son & Co. Bedford, Eng.
Hare Eng. Co., Toronto.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.

Feed Water Alarms.
H. L. Peiler & Co., Montreal.

Feed Water Analyser.
H. L. Peiler & Co., Montreal.

Feed Water Heaters.
Alberger Condenser Co., New York.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
International Engineering Works, Ltd., Amherst, N. S.
Nobis Engineering Co., Toronto.
The Sims Co., Erie, Pa.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.

Filters.
John McDougall Caledonian Iron Wks, Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.,
Theodore Kipp Co., Winnipeg.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Reddaway & Co., F., Montreal.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnaces.
Monarch Electric Co., St. Lambert.

Furnace Linings.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.

Fuses, Renewable.
Economy Fuse & Mfg. Co. of Canada, Montreal.

Gaskets, Rubber, Asbestos, Lead and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Durabla Mfg. Co., New York.
Frick Co., Waynesboro, Franklin Co.,
Goetze-Gasket & Packing Co., New Brunswick.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.

Gas Exhausters.
Hare Eng. Co., Toronto.

Gas Producer Plants.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene & Oil Storage & Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
Durabla Mfg. Co., New York.
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.

Gears, Cut, Worm, Mortise.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Generators.
W. H. Allen Son & Co., Bedford, Eng.
Siemens Co. of Canada, Ltd. Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.

Governors, Water Wheel
W. H. Allen Son & Co., Bedford, Eng.

Graphite, Boiler.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Governor, Water Wheel.
Can. Allis-Chalmers, Ltd., Toronto.

Graphitol.
British Pacific Supply Co., Victoria.
C. C. Snowdon, Calgary.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.

Grease Cups.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.

Greases.
British Pacific Supply Co., Victoria.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
The Sims Co., Erie, Pa.

Heating Engineers.
Nolis Engineering Co., Toronto.
Theodore Kipp Co., Winnipeg.

Hoists.
Engineering Works of Canada, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Nobis Engineering Co., Toronto.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Engineering Works of Canada, Ltd., Montreal.
John McDougall Caledonian Iron Wks, Montreal.
Nobis Engineering Co., Toronto.

Hydraulic Presses.
Bawden Machine Co., Toronto.

Ice Making Machinery.
Arctic Ice Machine Co. Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co.,
Linde British Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

Insulators.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Geo. H. Tod, Toronto.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
The Maihak Indicator Agy., Montreal.

Indicators—Ammonia, Hydraulic.
Detroit Lubricator Co., Walkerville.

Indicating.
Renown Engine & Machine Co., Montreal.

Injectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Iron Filler.
Imperial Waste & Metal Co., Montreal.

Journal Greases.
Commercial Oil Co., Hamilton.

Lace Leathers.
Graton & Knight Mfg. Co., Worcester, Mass.

Lamps, Tungsten, etc.
Canadian General Electric Co., Ltd., Toronto.
Can. Sunbeam Lamp Co., Toronto.

Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.

Lubricants.
British Pacific Supply Co., Victoria.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary
Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Hare Eng. Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Metal Spools.
American Pulley Co., Philadelphia.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.
Siemens Co. of Canada, Ltd. Montreal.

Metres, Steam.
Nobis Engineering Co., Toronto.

Meters, Water.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Mica.
Kent Brothers, Kingston, Ont.

Mill Supplies.
Andrews & Son, F. H., Quebec.
Reddaway & Co., F., Montreal.

Mill and Mining Machinery.
W. H. Allen Son & Co., Bedford, Eng.

DART

Union Pipe Coupling

REDUCES EXPENSE

Absolutely Trouble-Proof

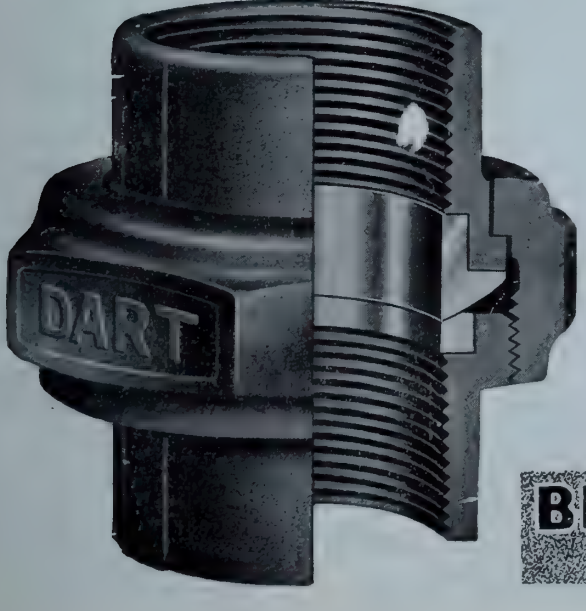
When pipes are connected with a Dart Union there is no possible chance of a leak, and as both faces are of bronze there is no corrosion at the joint.

After a Dart Union has served years in one place you can disconnect it and put it on some other job. It can be used over and over again, and still retain its original efficiency.

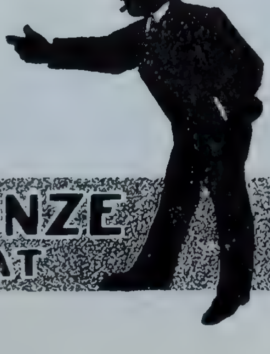
Vibration, contraction or expansion do not affect it in the slightest degree.

Every Dart Union bears the trade-mark as shown on illustration. This is our **guarantee**: we replace two for one any Dart found defective.

Sold by Jobbers from Coast to Coast.



Dart Union Co., Limited
TORONTO, ONT.



BRONZE TO BRONZE
AT THE JOINT

Can. Fairbanks-Morse Co., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Jenckes Machine Co. Sherbrooke, Que
International Engineering Works, Ltd., Amherst, N. S.
Goldie & McCulloch Co., Galt.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
Bawden Machine Co., Toronto.

Motors.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Motor Starters and Controllers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Office Railings.
Jas Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
S. F. Bowser & Co., Inc., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
S. F. Bowser & Co., Inc., Toronto.
Theodore Kipp Co., Winnipeg.
Lunkenheimer Co., Cincinnati, Ohio.

Oils, Lubricating.
British Pacific Supply Co., Victoria.
Can. Oil Companies, Ltd., Toronto.
C. C. Snowdon, Calgary.

Packing Engine.
Canadian Gasket Co., Bridgeburg, Ont.
Can. H. W. Johns-Manville Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.

Packing, Hydraulic.
Greene, Tweede & Co., New York.

Packing, Metallic.
Canadian Gasket Co., Bridgeburg, Ont.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
Canadian Gasket Co., Bridgeburg, Ont.
Canadian H. W. Johns-Mansville Co., Toronto.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Greene Tweed & Co., New York.
Nobis Engineering Co., Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
Graton & Knight Mfg. Co., Worcester, Mass.

Patents.
Rowland Brittain, Vancouver, B.C.

Penstocks.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.

Pillow Blocks.
Can. Bond Hanger & Coupling Co., Alexandria.
Elmira Machinery & Transmission Co., Elmira, Ont.

Pipe Bending.
Nobis Engineering Co., Toronto.

Pipe Coils.
National Pipe Bending Co., New Haven, Conn.
York Mfg. Co., York, Pa.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
Oster Mfg. Co., Cleveland, O.

Pipe, Steel.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Pipe (Second-Hand).
Imperial Waste & Metal Co., Montreal.

Pipes, Water.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.

Piping and Fittings.
Frick Co., Waynesboro, Franklin Co., Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.

Plate Work.
Can. Allis-Chalmers, Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

Pneumatic Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Polish, Metal.
G. W. Hoffman, Indianapolis.

Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
American Pulley Co., Philadelphia.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Ca., Elmira, Ont.
Engineering Works of Canada, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.
Siemens Co. of Canada, Ltd. Montreal.

Pulleys.
American Pulley Co., Philadelphia.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira, Ont.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.

Pump Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.

Pumps, Air.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Contractors'.
W. H. Allen Son & Co., Bedford, Eng.
William Hamilton Co., Ltd., Peterborough.

Pumps, Hand and Power.
S. F. Bowser & Co., Inc., Toronto.

Pumps, Centrifugal.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Engineering Works of Canada, Ltd., Montreal.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks. Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Hydraulic, Pressure.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Pump Leathers.
Graton & Knight Mfg. Co., Worcester, Mass.

Pumps, Oil.
The Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
Can. Detroit Lubricator Co., Walkerville, Ont.
The Lunkenheimer Co., Cincinnati, O.
Manzel Cros. Co., Buffalo, N.Y.
Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Steam.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Triplex.
William Hamilton Co., Ltd., Peterborough.

Pumps, Vacuum.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
C. A. Dunham Co., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Pump Tank, Receiver.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.

Pyrometers.
Jas. Morrison Brass Mfg. Co., Toronto

Rails (Relaying).
Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
Jas. Morrison Brass Mfg. Co., Toronto.

Reboilers.
Frick Co., Waynesboro, Franklin Co., Pa.

Recording Instruments.
Theodore Kipp Co., Winnipeg.

Reels.
American Pulley Co., Philadelphia.

Refrigerator Doors, Windows, Etc.
Jones Cold Store Door Co., Hagerstown, Ind.

Refrigerating Engineers.
Arctic Ice Machine Co., Canton, Ohio
Chas. Bishop, Montreal.
Can. De La Vergne Co., Limited, Montreal.

Refrigerating Machinery.
Arctic Ice Machine Co. Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Theodore Kipp Co., Winnipeg.
Linde British Refrigeration Co., Montreal.
Linde Can. Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

Regulators, Pressure.
C. A. Dunham Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.

Revolving Doors for Hardening Rooms.
Jones Cold Store Door Co., Hagerstown, Md.

Revolution Counters.
Maihak Indicator Agency, Montreal.

Rheostats.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co. Hamilton.
Siemens Co. of Canada, Ltd. Montreal.

Roofings—Asbestos and Wool Felts
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Rope Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Rope Preservative.
Cling Surface Co., Buffalo.

Rotary Converters.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd. Montreal.

Rubber Goods.
Canadian Consolidated Rubber Co., Ltd., Montreal.

Rubber Hose.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Quaker City Rubber Co., Philadelphia.

Runways, Hand Operated.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Runways, Electric.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Rubber Molds.
The Bawden Machine Co., Toronto.

Safes.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Safety Valves.
Can. Fairbanks-Morse Co., Montreal.
Lunkenheimer Co., Cincinnati, O.

Self-Landing, Self-Delivery Hoists.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Sash Pulleys.
American Pulley Co., Philadelphia.

Separators, Oil, Steam and Ammonia.
Frick Co., Waynesboro, Franklin Co., Pa.

Shafting.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford

Shaking and Dumping Grates.
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford

Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Sign Receptacles
Duncan Electrical Co., Montreal.

Smoke Consumers.
Canadian Steam Boiler Equipment Co., Toronto.

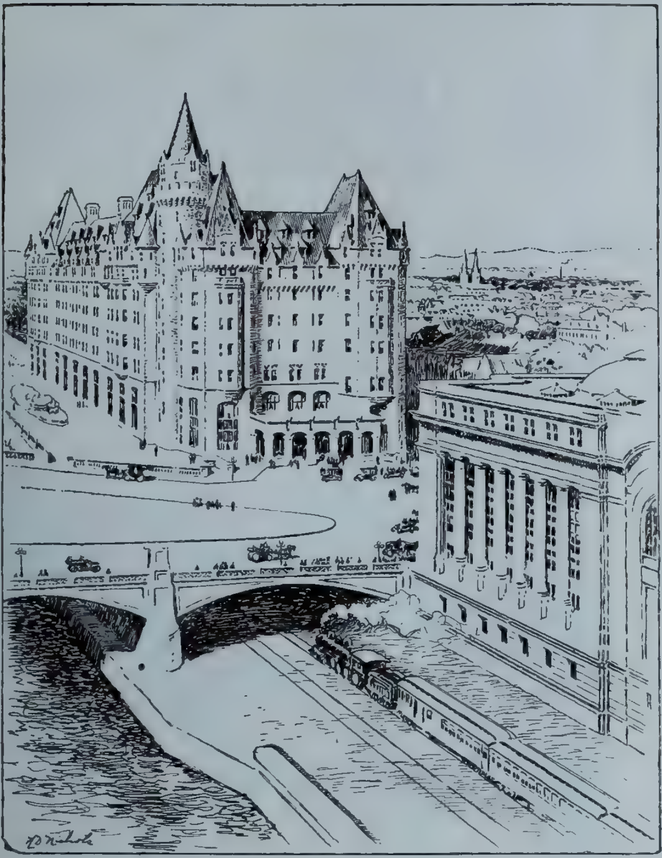
Smoke Boxes, Stacks.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Wks. Co., Brantford

Smokeless Furnaces.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks. ,Detroit, Mich.
Geo. H. Tod, Manning Chambers, Toronto.

Soot Cleaners.
Vulcan Tube Cleaning Systems, Ltd., Montreal.

Special Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford

Sprocket Chain Attachments.
Waterous Engine Wks. Co., Brantford



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Toronto MONTREAL Winnipeg

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- Can. Fairbanks-Morse Co., Montreal.
- Waterous Engine Wks. Co., Brantford

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- William Hamilton Co., Ltd., Peterborough.

Stationary Gas Engine Oil.
- Commercial Oil Co., Hamilton.

Steam Separators.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Watson & McDaniel Co. Philadelphia Montreal.
- Arctic Ice Machine Co., Canton, Ohio.

Steam Specialties.
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- D. G. C. Valve Co. of Canada, Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Hare Eng. Co., Toronto.
- Liberty Mfg. Co., Pittsburg, Pa.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co. Toronto.
- Ohio Brass Co., Mansfield; O.
- Penberthy Injestor Co., Windsor.
- Watson & McDaniel Co. Philadelphia
- Vulcan Tube Cleaning System, Ltd., Montreal.

Steam Traps.
- V. D. Anderson Co., Cleveland, O.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- G. M. Davis Regulator Co., Chicago.
- C. A. Dunham Co., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Hare Eng. Co., Toronto.
- Can .Morehead Mfg. Co., Woodstock,
- Nobis Engineering Co., Toronto.
- Peacock Bros., Montreal.
- Schneider & Helmecke, Madgeburg, Germany.
- Watson & McDaniel Co., Philadelphia

Steam Turbine Blowers.
- Hare Eng. Co., Toronto.
- International Engineering Works, Ltd., Amherst, N. S.

Steam Turbine Generators.
- W. H. Allen Son & Co. Bedford, Eng.
- Hare Eng. Co.. Toronto.
- International Engineering Works, Ltd., Amherst, N. S.
- Siemens Co. of Canada, Ltd. Montreal.

Steam Turbine Pumps.
- W. H. Allen Son & Co., Bedford, Eng.
- Hare Eng. Co., Toronto.

Steel Tanks.
- William Hamilton Co., Ltd., Peterborough.

Stokers.
- W. H. Allen Son & Co., Bedford, Eng.
- Ed. Bennis & Co., Little Hulton, Bolton, Eng.
- Hare Engineering Co., Ltd., Toronto.
- Jones Underfeed Stoker Co., Toronto.
- Murphy Iron Wks., Detroit, Mich.
- Theodore Kipp Co., Winnipeg.
- Geo. H. Tod, Manning Chambers, Toronto.

Strainers.
- W. H. Allen Son & Co., Bedford, Eng.
- Elliott Co., Pittsburg, Pa.

Superheaters, Steam.
- Babcock & Wilcox, Montreal.

Switchboards, Light and Power.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Engineering Works of Canada, Ltd., Montreal.
- Monarch Electric Co., St. Lambert, Que.
- Siemens Co. of Canada, Ltd. Montreal.
- Lunkenheimer Co., Cincinnati, O.

Switches and Switch Boxes.
- Canadian General Electric Co., Limited, Toronto.
- Canadian Westinghouse Co., Hamilton.
- Duncan Electrical Co., Montreal.
- Monarch Electric Co., St. Lambert, Que.
- Orenstein-Arthur Koppel Co., Pittsburg.
- Siemens Co. of Canada, Ltd. Montreal.

Tachographs.
- Maihak Indicator Agency, Montreal.

Tachometers.
- Maihak Indicator Agency, Montreal.

Tanks, Blow-off.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- John McDougall Caledonian Iron Wks. Montreal.

Tanks, Freezing, Storage and Water Cooling.
- Frick Co., Waynesboro, Franklin Co., Pa.

Tanks, Oil.
- S. F. Bowser & Co., Inc., Toronto.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que.
- Waterous Engine Wks. Co., Brantford

Tanks, Water.
- Can. Allis-Chalmers, Ltd., Toronto.
- Pac. Coast Pipe Co., Vancouver, B.C.

Technical Books.
- Am. School of Correspondence, Chicago.

Telephones.
- Northern Electric & Mfg. Co., Limited. Montreal.

Track Systems.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Transformers.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Engineering Works of Canada, Ltd., Montreal.
- Monarch Electric Co., St. Lambert, Que.
- Siemens Co. of Canada, Ltd. Montreal.

Transmission Machinery.
- Can. Bond Hanger & Coupling Co., Alexandria, Ont.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery & Transmission Co., Elmira, Ont.
- Goldie & McCulloch Co., Galt, Ont.
- Jeffrey Manufacturing Co., Columbus.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Waterous Engine Wks. Co. Brantford

Trolleys.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Trolley Hoists.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Trucks, Factory.
- Can. Fairbanks-Morse Co., Montreal.

Tube Cleaners.
- Can. Allis-Chalmers, Ltd., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Liberty Mfg. Co., Pittsburg, Pa.

Tube Cutters.
- Liberty Mfg. Co., Pittsburg. Pa.

Tubes, Boilers.
- Babcock & Wilcox, Montreal.

Tube Expanders.
- Liberty Mfg. Co., Pittsburg. Pa.

Tungsten Lamps.
- Can. Sunbeam Lamp Co., Toronto.
- Can. Tungsten Lamp Co., Hamilton, Ont.
- Canadian General Electric Co., Ltd., Toronto.
- G. Lewis, Montreal.

Turbine Water Wheels.
- W. H. Allen Son & Co., Bedford, Eng.
- Canadian Boving Co., Hamilton.
- Chas. Barber & Sons, Meaford, Ont.
- Engineering Works of Canada, Ltd., Montreal.
- Escher, Wyss & Co., Toronto.
- Jenckes Machine Co., Sherbrooke, Que.
- William Hamilton Co., Ltd., Peterborough.

Turbines, Steam.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Engineering Works of Canada, Ltd., Montreal.
- Escher, Wyss & Co., Toronto.
- Hare Eng. Co., Toronto.
- International Engineering Works, Ltd., Amherst, N.S.
- Theodore Kipp Co., Winnipeg.
- Laurie & Lamb, Montreal.
- John McDougall Caledonian Iron Wks. Montreal.

Turntables
- Orenstein-Arthur Koppel Co., Pittsburg.

Unions.
- Can. Fairbanks-Morse Co., Montreal.
- Dart Union Company, Toronto.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.

Vacuum Governors.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Canadian Steam Boiler Equipment Co., Toronto.
- G. M. Davis Regulator Co., Chicago.

Vacuum Regulating Valves.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Vacuum Traps.
- D. G. C. Valve Co. of Canada, Toronto.
- C. A. Dunham Co., Toronto.
- Can. Morehead Mfg. Co., Woodstock, Ont.

Valve, Disk.
- Durabla Mfg. Co., New York.
- Goetze-Gasket & Packing Co., New Brunswick, N.J.

Valve Oils.
- Commercial Oil Co., Hamilton.

Valve, Reseating Machines.
- Darling Bros., Montreal.

Valves.
- Can. Allis-Chalmers, Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian Steam Boiler Equipment Co., Toronto.
- D. G. C. Valve Co. of Canada, Toronto.
- Frick Co., Waynesboro, Franklin Co., Pa.
- G. M. Davis Regulator Co., Chicago.
- Hare Eng. Co., Toronto.
- Homestead Value Mfg. Co. Pittsburg.
- Jenkins Bros., Montreal.
- Kerr Engine Co., Walkerville, Ont.
- Liberty Mfg. Co., Pittsburg. Pa.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Nobis Engineering Co., Toronto.
- Ohio Brass Co., Mansfield, Ohio.
- Watson & McDaniel Co. Philadelphia

Valves, Blow-off.
- Can. Fairbanks-Morse Co., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Engineering Specialties Co., Toronto.
- Jenkins Bros., Ltd., Montreal.
- Lunkenheimer Co., Cincinnati, O.
- Watson & McDaniel Co. Philadelphia

Valves, Gates.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Ohio Brass Co., Mansfield. Ohio.

Valves, Reducing.
- Liberty Mfg. Co., Pittsburg, Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Ohio Brass Co., Mansfield, Ohio.
- Watson & McDaniel Co. Philadelphia
- H. Mueller Mfg. Co., Ltd., Sarnia, Ont.

Valves, Radiator.
- D. G. C. Valve Co. of Canada, Toronto.
- Jenkins Bros., Ltd., Montreal.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Ohio Brass Co., Mansfield, Ohio.

Valves, Throttle.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.

Vaults & Vault Doors.
- Can. Fairbanks-Morse Co., Montreal.
- Goldie & McCulloch Co., Galt.

Ventilating.
- Nobis Engineering Co.. Toronto.
- Theodore Kipp Co., Winnipeg.

Voltmeters.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton
- Siemens Co. of Canada, Ltd. Montreal.

Washers, Leather.
- Graton & Knight Mfg. Co., Worcester, Mass.

Waste and Wipes.
- Imperial Waste & Metal Co., Montreal.

Water Columns, Gauges.
- Elliott Co., Pittsburgh. Pa.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- W. J. Wall, Montreal.

Water Hose.
- Liberty Mfg. Co., Pittsburgh, Pa.

Water Level Regulators.
- Hare Eng. Co., Toronto.

Water Lifters.
- Watson & McDaniel Co. Philadelphia

Water Motors.
- Elliott Co., Pittsburgh, Pa.

Water Purifiers, Softeners.
- Babcock & Wilcox, Montreal.
- Nobis Engineering Co., Toronto.

Water Wheels.
- Chas. Barber & Sons, Meaford, Ont.
- John McDougall Caledonian Iron Wks. Montreal.
- William Hamilton Co., Ltd., Peterborough.

Whistles, Plain or Chime.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.

Wire, Bare and Insulated.
- Canadian General Electric Co., Ltd., Toronto.
- Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wire, Magnet and Trolley.
- Canadian General Electric Co., Ltd., Toronto.
- Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wire, Railway Feeder and Trolley.
- Canadian General Electric Co., Ltd., Toronto.
- Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wrenches.
- Greene, Tweed & Co., New York.

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SAFETY PLASTIC
METALLIC PACKING

Practically Frictionless

FOR STEAM, WATER, AIR, GAS, ETC.
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

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6, 12, 25 and 50 lbs.

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Any Quantity sent
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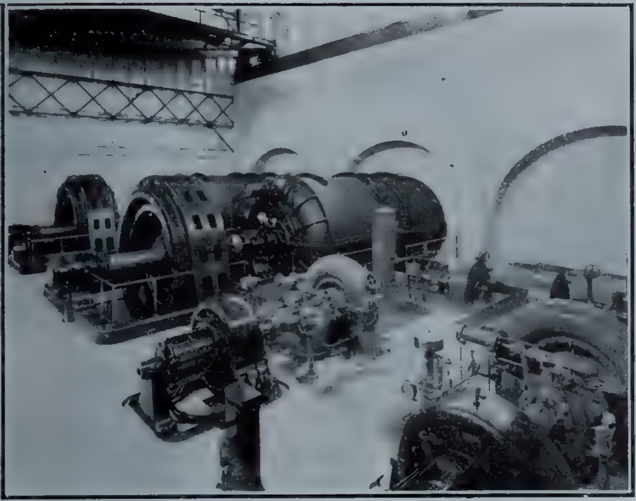

52,000 H.P. Plant Western Canada Power Co.

HYDRAULIC
STEAM
PUMPING
PLANTS

HEAD OFFICE FOR CANADA:

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THESE are some of the largest generators in the world and are used for manufacturing products of nitrogen from the air.

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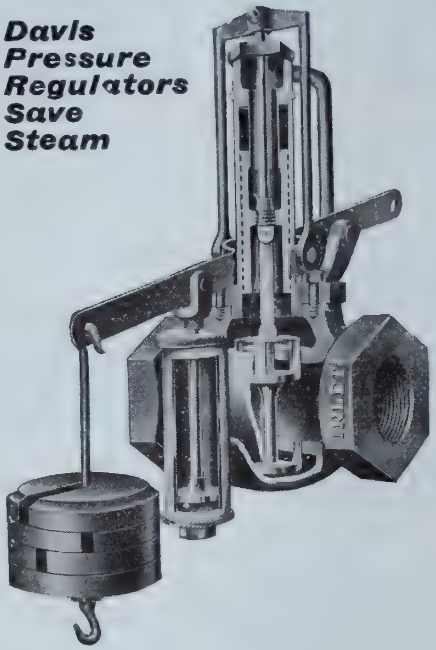
Put this valve on your steam line and forget about the pressure.

Davis Pressure Regulators Save Steam



Besides the economy of the thing, there is much satisfaction in being able to get any pressure you want in your plant regardless of the boiler pressure.

No matter what the operating conditions may be, if the result you want to get is a lower pressure for a given purpose, you have at your command the

DAVIS Pressure Regulator

This automatic valve may be set for any delivery. Fluctuations in the high pressure do not affect its action, and it is good for years of service because it is very simple in construction.

All Davis Pressure Regulators are sold on approval at our risk. They must satisfy you fully or there is no sale. Let us have your inquiries.

Made in all sizes from ½ to 14-inch, with either screwed or flanged ends.

G. M. Davis Regulator Co.
434 Milwaukee Ave. Chicago
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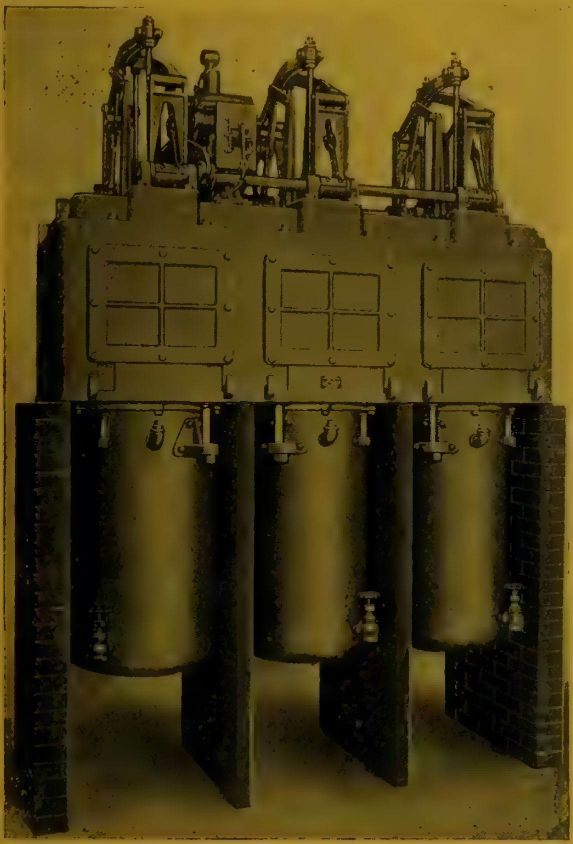
Westinghouse

Reactance-Type Circuit Breakers

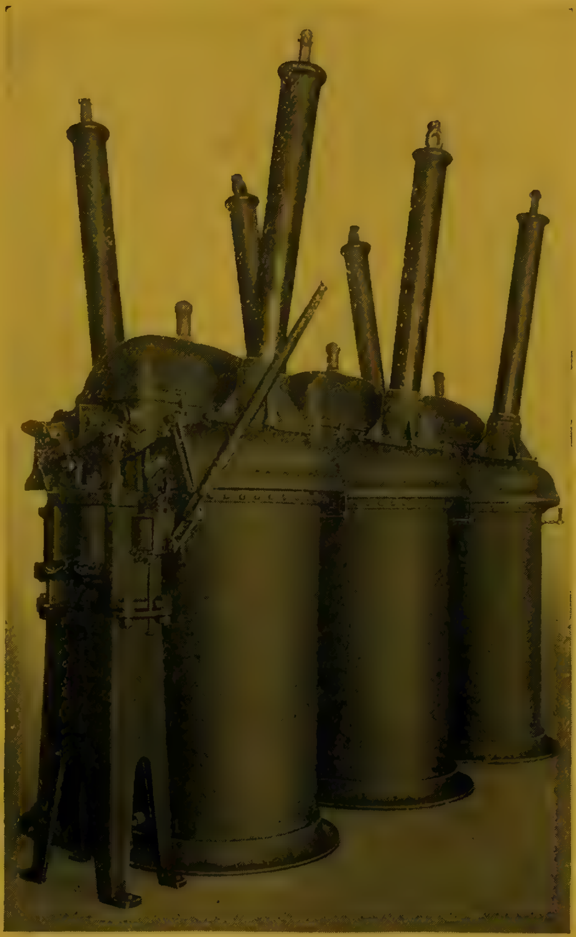
THESE breakers have two sets of contacts giving four breaks per pole, with self-contained reactance in shunt to one set of contacts.

One set of contacts opens first, thereby cutting the reactance into the circuit. The second set of contacts then act immediately, completely opening the circuit. The proper sequence of operation is insured by a positive mechanical interconnection.

This action first limits the flow of current under short-circuit conditions, and absorbs the inertia and stored energy of the system, making the work of the final pair of breaks relatively light.



Westinghouse Reactance-Type Circuit Breaker, Solenoid Operated, showing cell structure with doors removed. Capacities up to 1,200 amperes and 25,000 volts.



Westinghouse Reactance-Type Circuit Breaker Solenoid Operated. For floor mounting, showing breaker open with hand-closing lever in position. Capacities 600 amperes and 110,000 volts. Can be furnished for outdoor mounting.

This scheme of operation limits the work to be performed by the circuit-breaker mechanism, and makes possible a construction of practically unlimited circuit-breaking ability.

Reactance-Type Circuit Breakers are primarily intended for use as feeders, or automatic bus-tie breakers directly on the busses, which in turn are fed directly from a battery of large capacity generators or transformers.

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The Morrison Improved J. M. T. Injector

The J. M. T. Injector works under a greater range of pressures than any other injector on the market, operating perfectly on steam pressures from 20 to 220 lbs. gauge. It delivers hot water to boiler at 160° to 212° Fah., according to temperature of feed water and steam pressure. 200° to 212° can always be delivered at nearly all pressures over 50 lbs. by throttling suction valve and delivering the minimum capacity.

The J. M. T. Improved is the acme of simplicity. Any one can take it apart for cleaning with no other tool than an ordinary wrench. All high-pressure injectors are fitted with our improved drain valve, which enables the machine to be drained when necessary to prevent freezing. This valve is also of great assistance in starting on low pressures, and also furnishes a means of obtaining a supply of hot water.

Morrison Brass Valves

We manufacture a complete line of brass valves and cocks for every purpose. The design of these valves represents an experience extending over thirty years. The metal is selected in each case for the purpose for which the valve is intended. The foundry and machine work are all that careful factory methods can accomplish. Each valve is finished and fully tested under pressure before leaving our factory.

There is
A DIFFERENCE

There is a vast difference between steam specialties that LOOK good and STEAM SPECIALTIES that ARE good. The difference is that between a plant always giving trouble—with the engineer working all day Sunday repacking valves, adjusting traps and lubricators, and so on, only to have it all to do over again a week later—and the plant that runs itself, almost, year in and year out.

For more than thirty years we have been making STEAM SPECIALTIES THAT ARE GOOD, and in each of those years studying to make better products than we made the year before. We do not claim perfection, even yet, BUT, we do give you an unconditional guarantee with every article we make.

The J.M.T. trade-mark on a power plant accessory means that that article will do everything that we said it would do and will do it continuously without undue attention. It is an assurance that costs you nothing. It is one of the benefits YOU derive from OUR experience.

We have a complete line of Power Plant Accessories and Brass Fittings for every purpose. Ask us for a catalogue of the line in which you are interested.

The James Morrison Brass Mfg. Company, Ltd.

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Special Feature—Articles on Power Transmission

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

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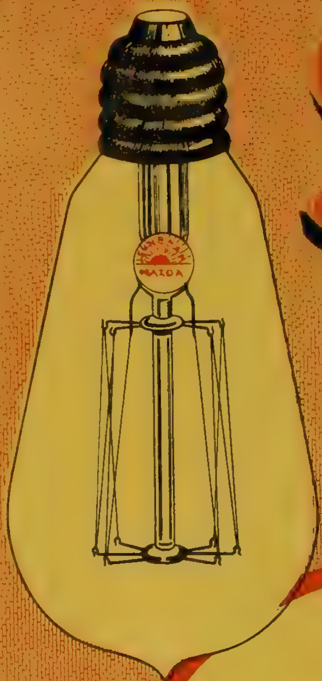
Vol. VII. Publication Office, Toronto—April, 1914 No. 4

"THE BEST BY EVERY TEST"

Insist on the Genuine. Look for Trade-Mark on body

Manufactured by

Penberthy Injector Co., Limited **Windsor, Ont.**



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Mazda Lamps

Give the light of THREE Carbons and consume only the current of one

Strong and Durable

Sunbeam Lamps are made to stand vibration—in fact, they are so durable that they have been adopted for service in fast trains, street cars and automobiles.

You can burn a Sunbeam Mazda in any position without shortening its life.

Cut costs now. Order Sunbeam Mazda Lamps.

We guarantee satisfaction and ship promptly.

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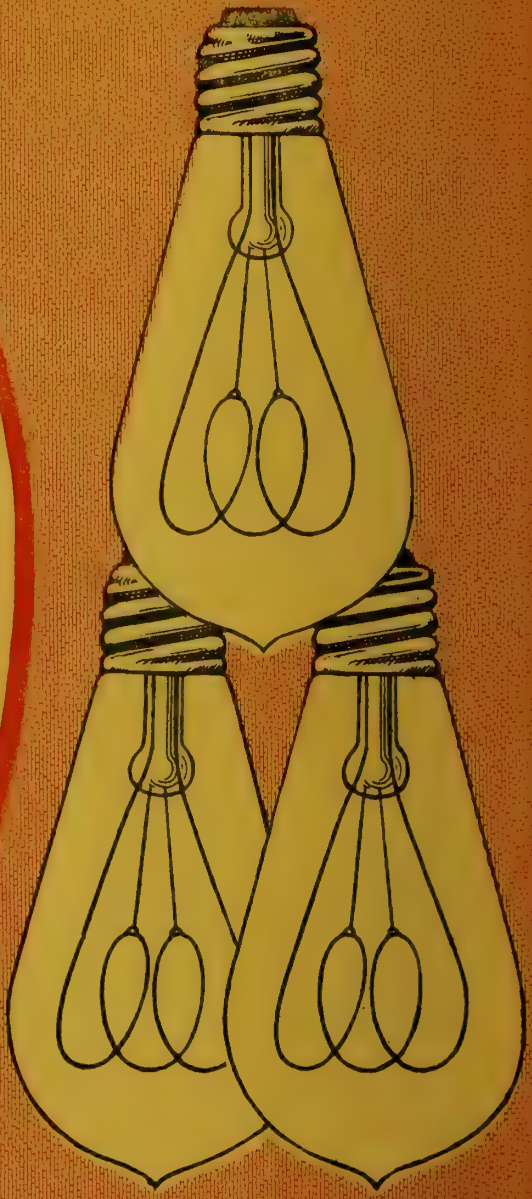

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Coal and Ash Elevator for the Montreal Light and Power Co., Montreal.

STEEL PLATE WORK—

The various kinds of Steel Plate Work used in the modern power plant are turned out by our boiler shop. We build tanks, bins, steel chutes and troughing, smoke breechings, stacks, etc., in all sizes, built to order to suit individual requirements.

By keeping a separate department constantly busy on this work, we have acquired invaluable experience in handling these special jobs to keep down manufacturing costs.

That's why we are able to turn out special built-to-order plate work at a price that is not special.

Send us your sketches for this work. Our prices will suit you.

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA

Winnipeg, Man. **Vancouver, B.C.**

THE BALLAD OF THE B.T.U.

Said the B. T. U. to the Old Boiler Flue,
  As he quivered and shed a tear,
"I am cussed and maligned, tho the fault is not mine,
  For my failure to make good here.

"I simply can't keep those units all hot,
  When they're half full of condensation.
When traps work as they should, it's a cinch to make good,
  But I'm tired of this situation.

"It's no wonder they're cold, for, as I am told
  By the contractors, estimators,
Most any old trap that would fit on the tap
  Was screwed into these radiators."

"Have cheer," said the Flue to the peeved B. T. U.,
  "Your troubles will soon end, perhaps,
For I heard the Boss say to the fitters to-day,
  He was going to put on new traps."

And the very next morning, without any warning,
  The fitters came on in a mob,
And with wrenches and taps and good Dunham Traps,
  They replaced every trap on the job.

Said the B.T.U. to the Old Boiler Flue,
  And he chuckled in cheerful mood,
"These new traps are fine; it's the Dunham for mine,
  I think I'll stay now and make good."

LISTEN:

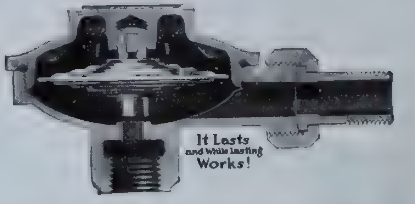
DO your B. T. U.'s give you satisfaction and full value?

IF NOT, have you ever taken the trouble to investigate and find out WHY NOT?

IS IT leaky, faulty radiator traps, or maybe the need of good traps?

The B. T. U. Ballad may be chanted to a successful ending of your boiler troubles and cold Radiators if you ask us about the

Dunham Radiator Trap



Performs the functions of a Radiator Steam Trap perfectly and continuously. Eliminates water and air without loss of steam.

Let us get together on your particular proposition of heating. We can do each other good.

Write for our new Bulletin Catalog and particulars TO-DAY.

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

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OUR MIXED METAL SALES AMOUNT TO OVER 5,000000 DOLLARS ANNUALLY

Also Behind Our
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WIRE SOLDER
LEAD PIPE
BAR LEAD
TRAPS, BENDS,
LEAD, COPPER, TIN
AND ANTIMONY

For high-speed machinery and engine work, Frost King Babbitt Metal is, we believe, without an equal. It is especially designed for Saw Mills, Planing Mills, Threshing Machines, Traction Engines, Pumps, Rolling Mills, and Pulp Machinery, and all classes of Stationary Engines.

35 years' experience in selecting and compounding of stock means that our products are of very high quality.

Hoyt Metal Co., Toronto, Ont.

New York, N.Y.
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JENCKES BOILERS

Constructed
for Long, Efficient Service
with Minimum Repairs

You will do well to investigate the JENCKES before placing that order for new boilers.

We are always ready to put you in touch with users.

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TUBULAR
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HEATING
BOILERS

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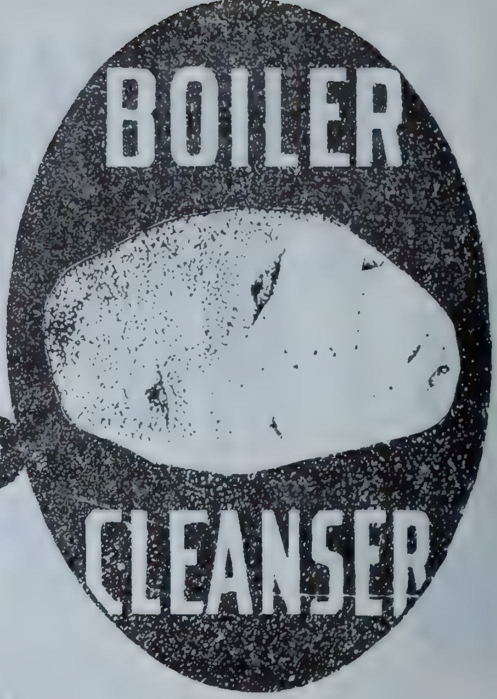
Works: SHERBROOKE, QUE. ST. CATHARINES, ONT.

Potato Scale



The destructive and money-wasting scale hasn't a "ghost" of a show where this boiler compound is used.

Its services ensure clean boilers, a minimum consumption of fuel, and freedom from pitting, corrosion, foaming and other troubles due to the impurities in the feed water.

There is nothing in its composition that can cause the slightest injury to metal.

We treat each case individually and **guarantee** satisfactory results.

Let us furnish you with references and full particulars. **Don't miss this opportunity to profit by the experience of other engineers.**

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a trial keg
Satisfaction or
no pay*

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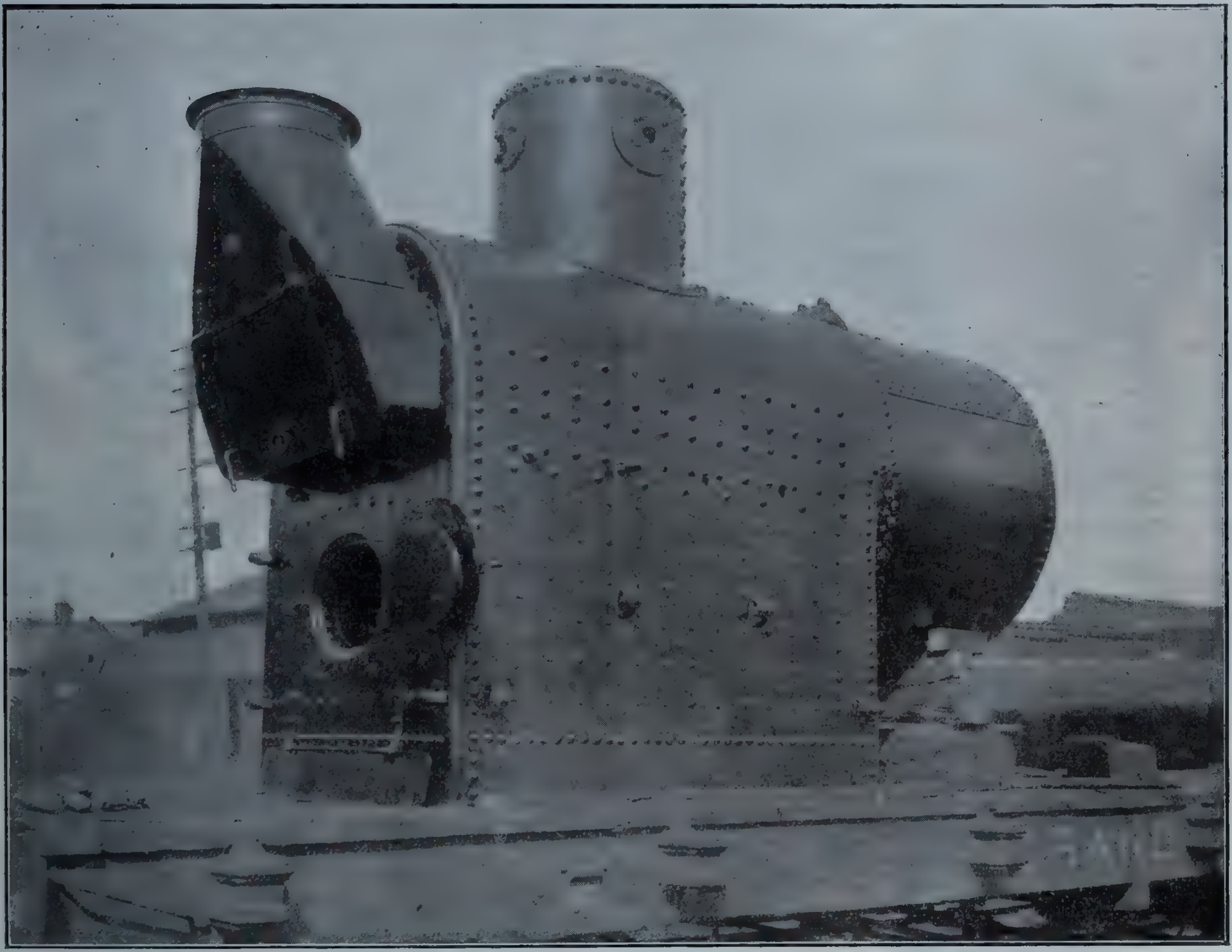
POLSON BOILERS

are built of best quality Flange Steel by skilled workmen.

The photo shows a 58″ square-firebox Marine Boiler that has just been completed by us for the LAKESIDE DREDGING CO.

It is just another example of the popularity of Polson products, amongst engineers and men who know and appreciate good equipment.

Put your plans and specifications up to us.

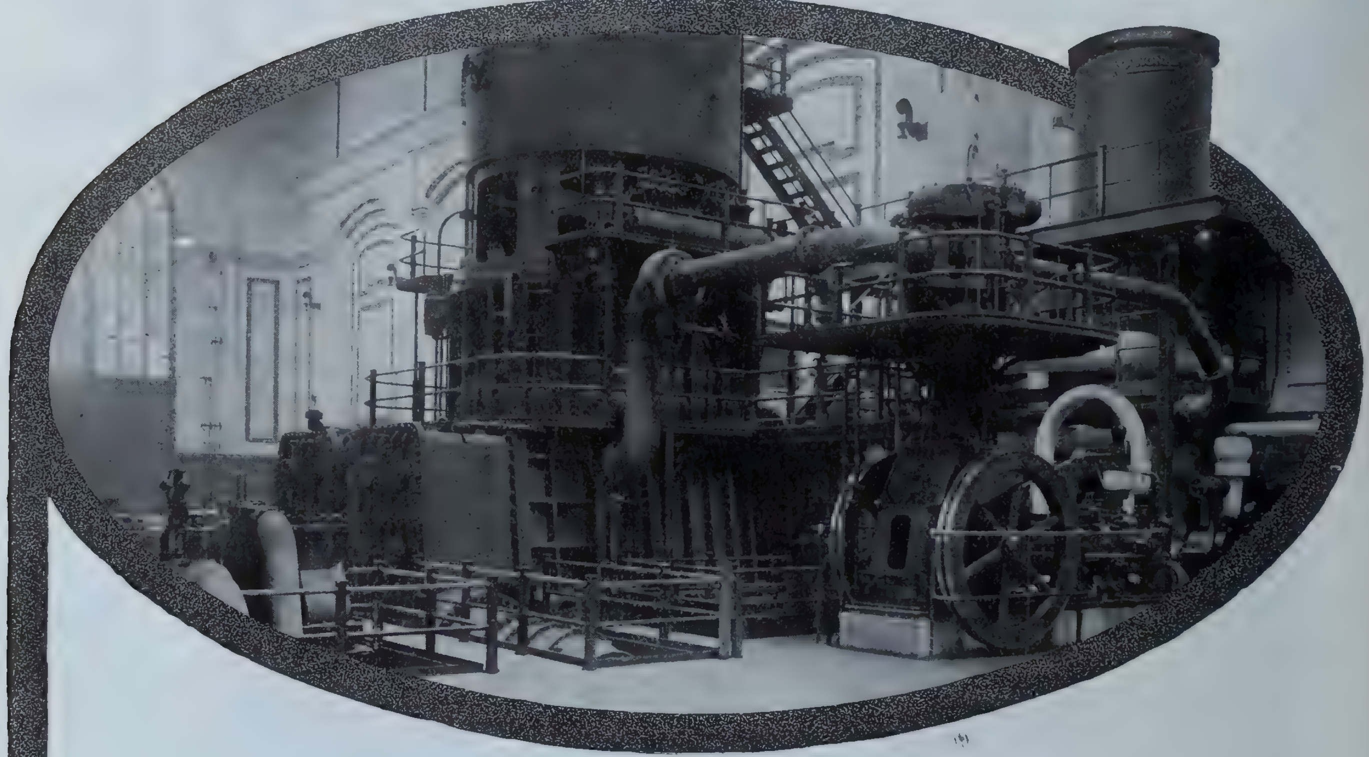


Polson Iron Works, Limited

Toronto, Ontario

In Power Plants such as this you find NATIONAL

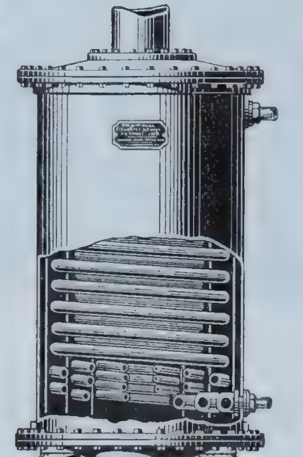
FEED WATER HEATERS



In this well-known power plant, with its big turbo-generators, there are now in operation 40,000 Horse Power of

NATIONAL

Feed Water Heaters



To the man who selects power plant apparatus this is significant—especially when one knows that it is the business of this company to generate and sell power and that it has one of the best equipped testing departments in the world.

Because of the reputation of the Nationals previously installed, the acceptance test in this case was very simple—the National handled all the steam from the big generator when operated at maximum overload.

The new catalogue No. 51 fully describes this feed water heater. Send for it.

The National Pipe Bending Co.

91 Lloyd Street, New Haven, Conn.
54 High Street, Boston 149 Broadway, New York

46-68

Always Remember

Perolin

is NOT a Boiler Compound—it's a GERMAN BOILER METAL TREATMENT

Guarantee

We guarantee **PEROLIN**, the German Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That **PEROLIN** is not a boiler compound for water treatment, but operates independent of water conditions;
7. The **PEROLIN** preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the **PEROLIN** protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

No matter from what source the feed water is obtained, its chemical composition is continually changing, due to climatic conditions and seasons. In periods of drought the soluble matter increases and water that will not ordinarily produce a heavy scale will cause endless trouble then.

While **Perolin** is used in a similar manner to boiler compounds, the **effect is different.** It works through the cracks in the scale to the boiler metal, and expands, loosening the scale so that it can be easily washed out. It forms a preservative film to which no scale-forming substance can adhere. This film is a good transmitter of heat and prevents pitting, corrosion, etc.

We have a letter from the Bureau of Inspection, Tests and Consultation, stating that **Perolin is harmless to metal.**

To convince you that Perolin will produce results for you, we offer to ship—freight prepaid—a sufficient quantity to **test for 60 days.** If it does not accomplish what we claim it will—return what you have left, and the amount used will cost you nothing. **Mr. Engineer, Perolin will make work easier and more pleasant for you.** Be sure to get your employer to try it. If he hesitates, write us and we'll send him some of the letters we've received from users. They'll change his attitude.

Perolin Company of Canada,
LIMITED

76 Adelaide St. West, Toronto, Ont.

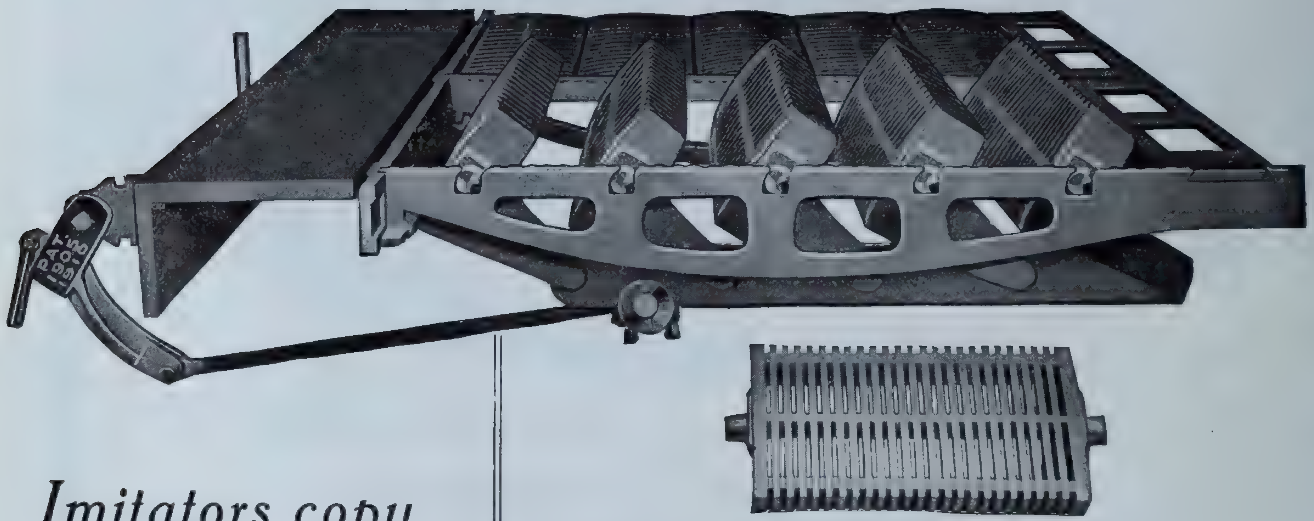
"THE Cyclone"

Shaking and Dumping Grate Bar

Saves Fuel and Labor

We Guarantee

that with the **CYCLONE SHAKING AND DUMPING GRATE** any grade of hard or soft coal, or screenings of same, can be burned with excellent results, both as regards Economy and Capacity, and that the total annual expense to the purchaser for coal, interest, depreciation, repairs, damage to boiler, liability of shut-down, etc., will be much less than will be the case with any type of Stoker or Grate on the market.



Imitators copy only the BEST— Cyclone Grates are imitated.

Thirty Days' Trial

We are prepared to install our grates in the plant of any reputable company on thirty days' trial, leaving it to the purchaser to say if the grate is, or is not, saisfactory at the end of that time. If satisfactory, we will expect payment on the terms agreed on, and if not, we will remove the grate from the premises without cost to the purchaser.

The Canadian Steam Boiler Equipment Co., Limited

SOLE MANUFACTURERS FOR CANADA

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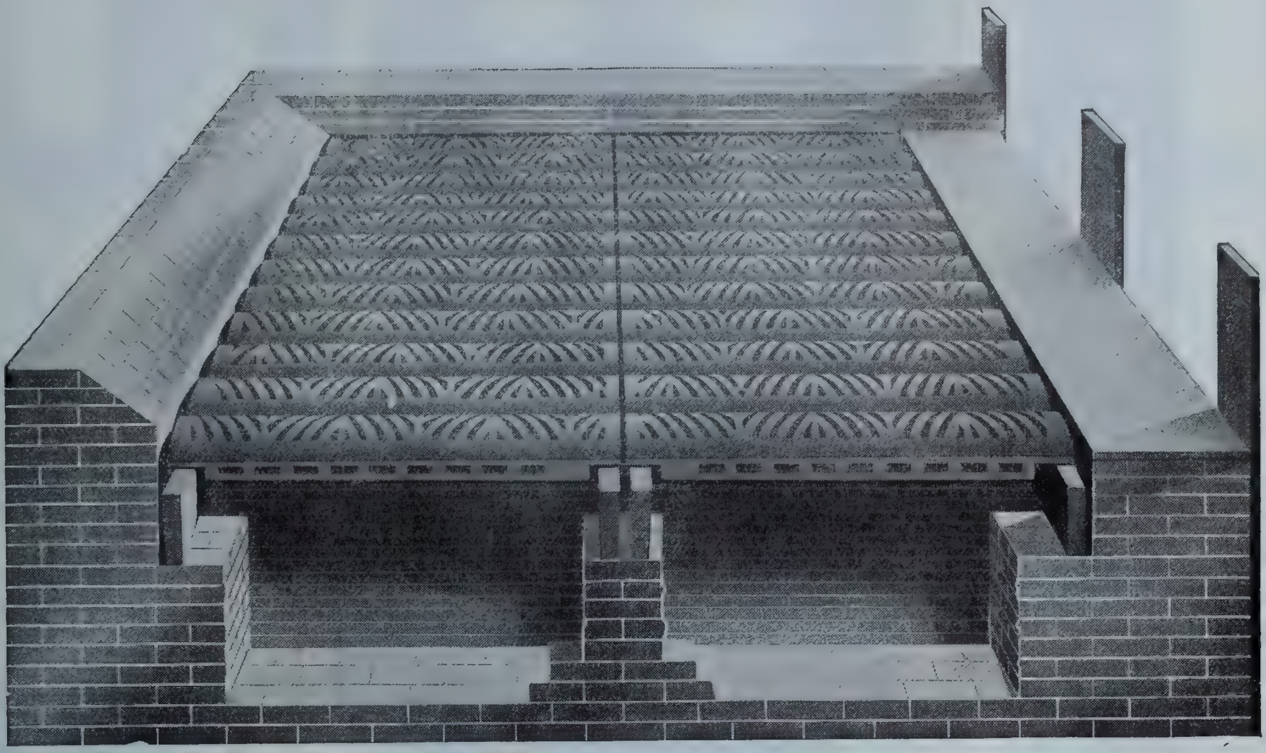
SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR—COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

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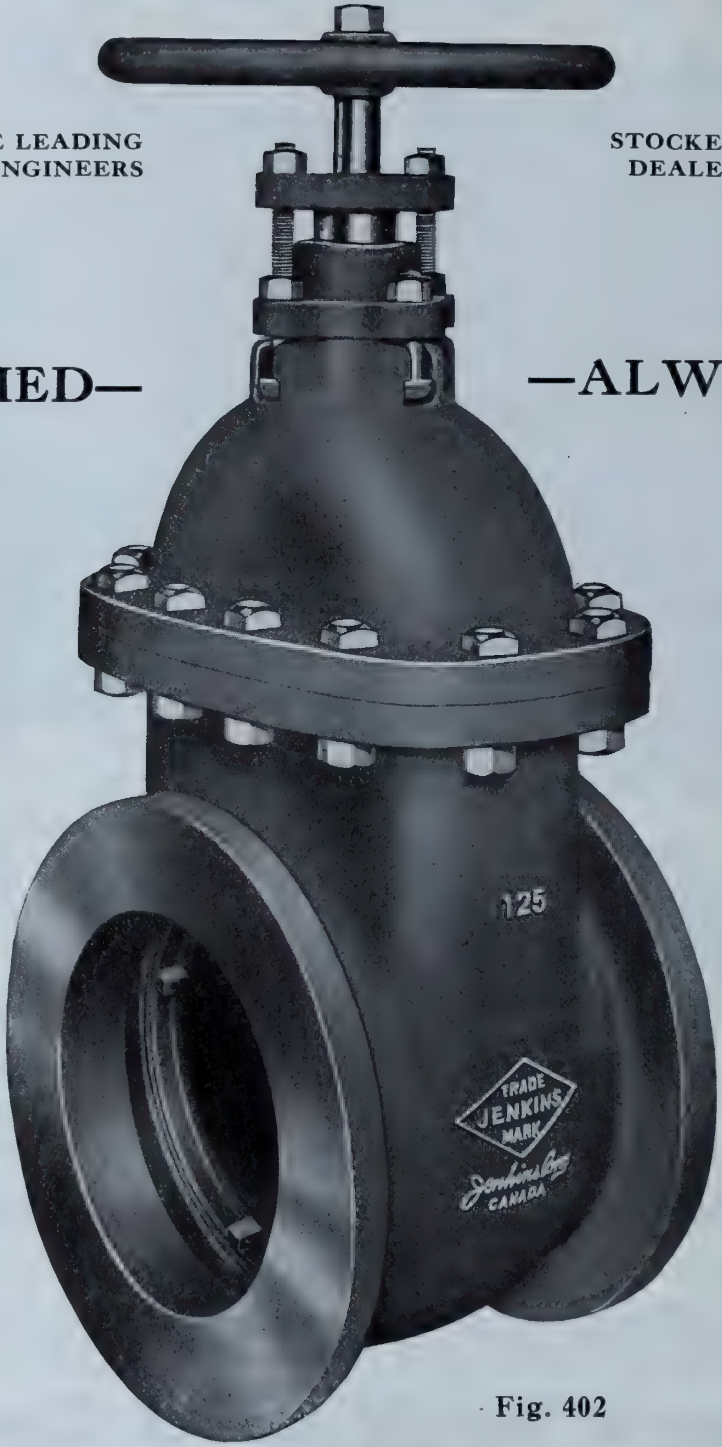
JENKINS BROS.' VALVES have STOOD the TEST and are STILL the BEST

TYPE "K" Iron-Body GATE VALVES — A New Line
UNRIVALLED in DESIGN, MATERIAL and WORKMANSHIP

ENDORSED BY THE LEADING ARCHITECTS AND ENGINEERS

STOCKED BY FIRST-CLASS DEALERS EVERYWHERE

ONCE TRIED— —ALWAYS USED



TESTED TO 300 lbs. HYDRAULIC PRESSURE

SUITABLE FOR 125 lbs. WORKING STEAM PRESSURE

OPENING EQUAL TO NOMINAL DIAMETER OF PIPE

BRONZE SEAT-RINGS SCREWED IN, AND RENEWABLE

DOUBLE COMPENSATING BRONZE-FACED DISCS

NO POSSIBILITY OF DISCS JAMMING

Fig. 402

CATALOGUE SENT FREE ON REQUEST

JENKINS BROS. Limited

103 St. Remi Street
MONTREAL

DART

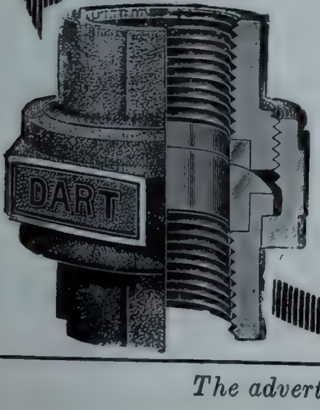
Both Faces are seated with BRONZE

which, you know, cannot rust or corrode

You can connect the "DART" easily and quickly whether pipes are in or out of alignment—and it will stay TIGHT till deliberately loosened with a wrench.

The "DART" Guarantee

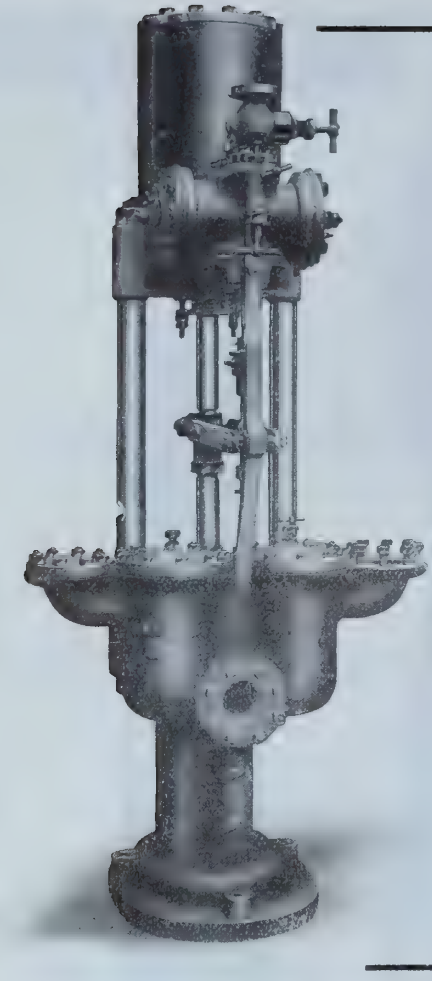
If any Union on which is cast the word "DART" is defective, send it to us or your jobber, and you will get two new ones for it.



Sold by Jobbers from coast to coast

Dart Union Co., Ltd.
TORONTO

Union Pipe Coupling



"WEIR"

THE UNSURPASSABLE PUMP

THE GREATEST EFFICIENCY. THE GREATEST ECONOMY.

Over 50,000 now in use.

Feeding Upwards of 120,000,000 Horse-Power

The Largest Vessel in the World,
The Largest Battleship in the World,
The Most Powerful Battle Cruiser,
The Fastest Torpedo Boat Destroyer,
The Most Luxurious Yacht Afloat,
The Greatest Dredger,
Are all fitted with WEIR AUXILIARIES.

The largest and most up-to-date plants in Canada are all equipped with

Weir Feed Pumps

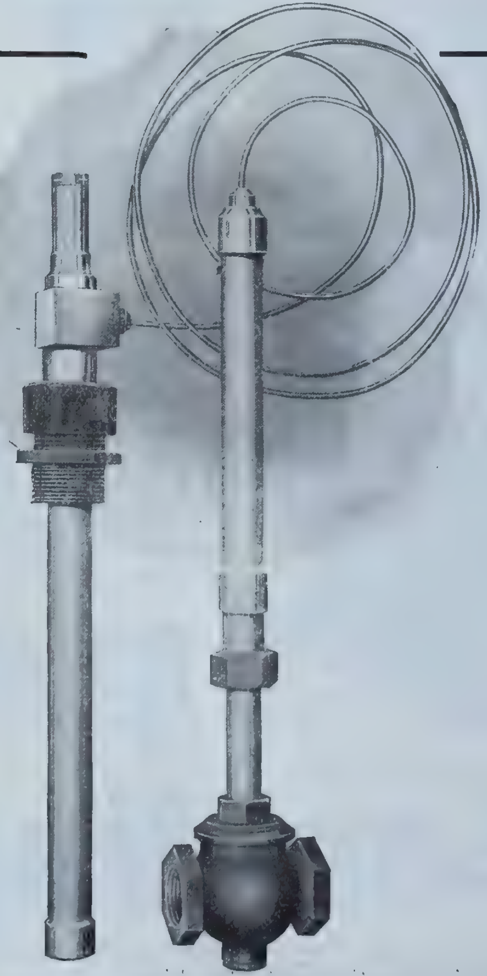
List of Canadian users sent upon application.

Send for catalogue No. 4.

SOLE AGENTS

PEACOCK BROTHERS

Montreal Vancouver



Slight Temperature Variations May Mean Heavy Losses

in many delicate manufacturing processes. If such a process is involved in the making of your product, you realize how vitally important it is that your thermostatic regulator should be absolutely accurate.

"SARCO"

Water Temperature Regulators

Are Good Insurance

against such losses.

Sarco Regulators depend for their action upon a principle that is absolutely positive and unchanging. The action of the thermostatic element depends on the expansion of a sensitive liquid hermetically sealed within a chamber. Into this chamber is inserted a flexible corrugated tube connected with valve-operating mechanism controlling steam or hot water inlet, according to the temperature in the tank or room.

No leaky air-valves, perishable rubber or leather diaphragms, or variable metal disc diaphragms are used in the Sarco. Sarco-Regulators are exceedingly simple and cannot get out of order.

Let us send you a bulletin with diagrams and descriptions of this instrument. Write for it.

We also sell "Sarco" Steam Traps, "Sarco" Smoke Recorders and "Sarco" Automatic Combustion Recorders. Bulletins sent on request.

PEACOCK BROTHERS
Montreal

PEACOCK BROTHERS
Vancouver, B.C.

A. R. ROBERTS
Winnipeg, Man.

When You Order

HIGH PRESSURE JOINTING

Specify

GARLOCK HOLDTITE

Because,

"Holdtite" will stand a varying temperature up to 572° Fahr. Has a tensile strength of 3 tons per square inch and stands a comprehensive strain of 14 tons and still retains it elasticity.

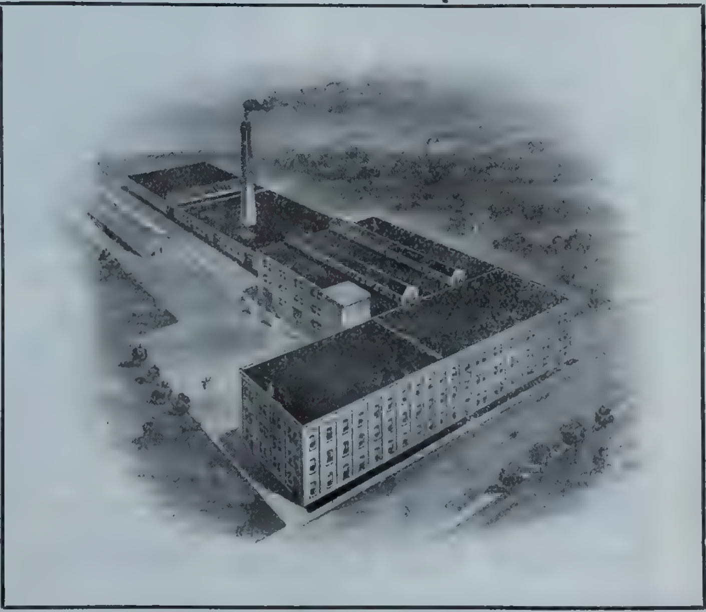
Put up in Sheets 40-in. x 40-in. in 1-32-in., 1-16-in., 1-8-in.

Write for sample and interesting information.

THE GARLOCK PACKING CO.
HAMILTON, ONT.

Montreal Toronto Winnipeg Calgary

"Pioneers in the Packing Business — and Specialists"



Works at Hamilton

Stop Blow-outs and Leaks in Pipe Lines by Using GOETZE No. 2 ELASTIC GASKETS

If you start right now to renew with No. 2 ELASTIC GASKETS, you can steadily reduce your renewals until you have brought them almost to the vanishing point.

This is not a mere "claim"—it is backed up by a *guarantee*—in fact the strongest guarantee ever made by a gasket manufacturer.

Think what it means to re-gasket a joint so it will *keep tight for years,* instead of days or weeks. Think of the saving resulting in gasket costs, labor and shut-downs.

What No. 2 Elastic Gaskets Will Do

No. 2 Elastic Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight. Prevent leaks, blow outs and shut-downs. Will practically eliminate renewal expense for gaskets.

No. 2 Elastic Gaskets are for high pressure and super-heated steam lines, but owing to their indestructible nature, are equally adapted to *any and every condition* about a factory, mill or refinery.

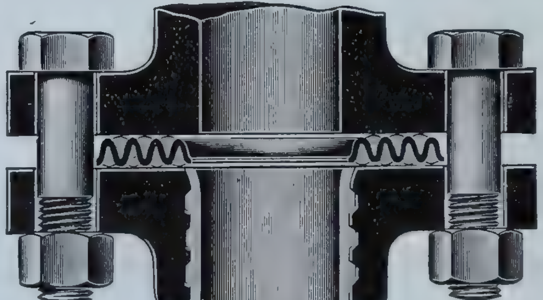
The No. 2 Elastic Guaranteed

Every No. 2 Elastic Gasket is Guaranteed for 5 Years' Continual Service in the Same Joint

There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every No. 2 Gasket whether bought direct from us or through a dealer.

How No. 2 Elastic Gaskets are Made

These Gaskets are made of corrugated copper with asbestos lining No. 2. The corrugations allow for expansion and contraction of the pipes, while the asbestos, being forced into the pores of the metals in the flanged surface by the "squeeze" and the constant pressure of the corrugations beneath it, holds securely against the highest pressures.



Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

ST. JOHN, N.B.

BRANCHES AT

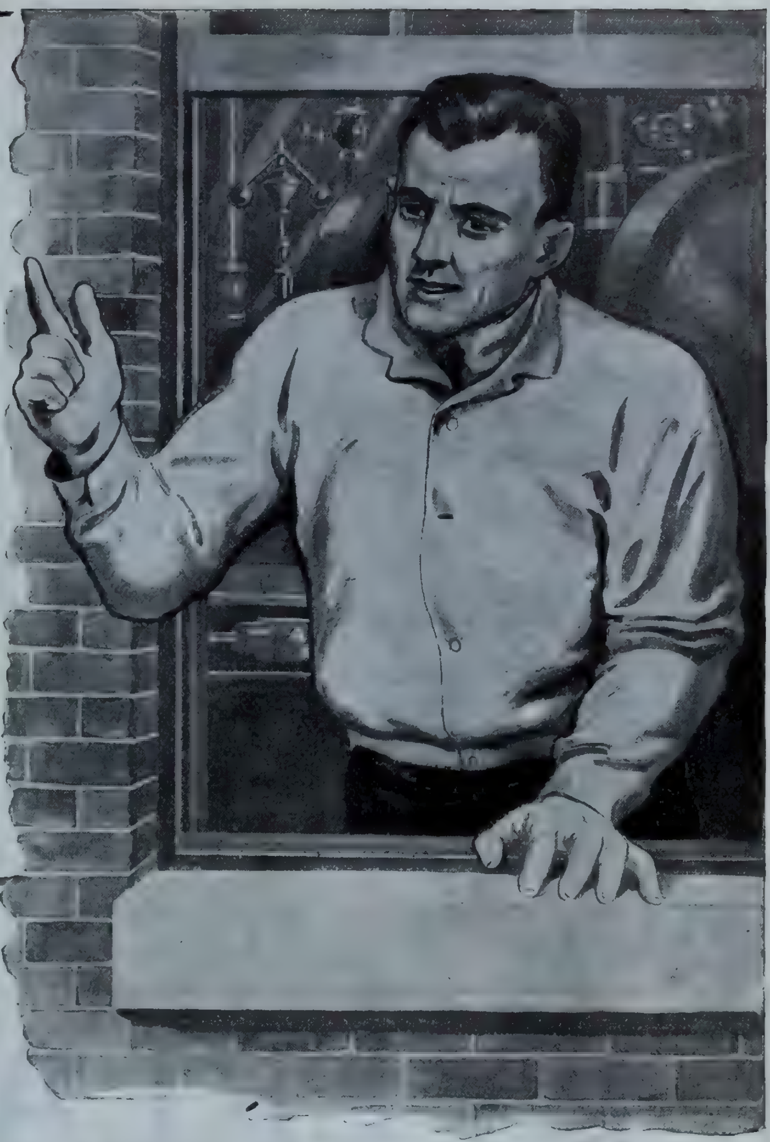
MONTREAL	TORONTO	WINNIPEG	LETHBRIDGE, Alta.	VANCOUVER
112 St. Peter St.	Mills Bros., 809 Lumsden Bldg	C. E. Chown, 425 Henry Ave.	J. B. Turney & Co.	c/o A. O. Campbell, 626 Pender St.

MANUFACTURED BY

Goetze Gasket & Packing Co., New Brunswick, N.J.

Don't Overlook This Fact

No packing containing rubber and canvas can possibly give satisfactory service under high pressure, superheated steam and compressed air pressures,—the temperature is too high.



"PALMETTO"

TWIST PACKING

is in no way affected by high temperatures and we put so much lubricant in each strand that it does not harden in service. You can count on "Palmetto" packing for

Long Service under Up-to-Date Conditions

Working samples of both the braided and twist without charge, to prove our claims.

Greene, Tweed & Co.
Sole Manufacturers
109 Duane St. New York

Canadian Distributing Agents, The Canadian Fairbanks-Morse Co., Ltd., Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

BENNIS
LONG-LIFE-LINK
CHAIN GRATE
STOKER

More air space is provided to each square foot of grate area than with other makes, and without additional widening of the *actual* air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

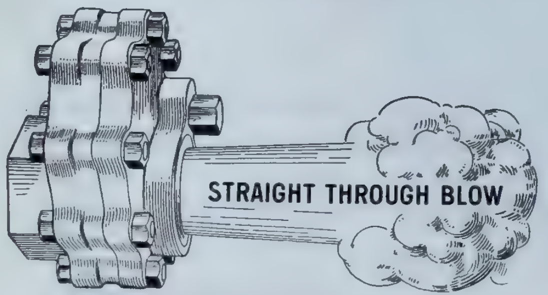
Fine slack fuels can be satisfactorily burnt.

Write for "Boiler House Economy" Pamphlets, and Full Particulars to

GEO. H. TOD, 213 Manning Chambers, Queen St. West,
WINNIPEG, 601 UNION BANK BUILDING **TORONTO**

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!
WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?
How often do you blow it?
The "EVERLASTING" is the only perfect blow-off valve on the market.
No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE. H. L. Peiler & Co.
CALGARY, ALTA. P. D. McLaren Limited
VANCOUVER, B.C. Taylor-Forbes Company, Limited
WINNIPEG, MAN. The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

"Samuel, My Product Is Also Counterfeited"

The reason Uncle Sam's money is counterfeited is because it is the genuine kind and has real value. And because P.P.P. has been proved by science and experience to have real value and because it is the geuine DANIEL'S are the reasons why other makers copy details of the packing and claim for their goods the results produced by ours.

DANIEL'S ROD PACKING

P. P. P.

COIL RING SPIRAL

Remember, P. P. P. is the original "sliding-wedge" packing—the **FIRST** and **ONLY** real improvement ever made in rod packings. None other is genuine. Accept no substitutes.

Last Chance to Get the Valve Book

We still have a few hundred copies of "The Slide Valve," a book that tells all about many types of slide valves—how they operate and how to set them. While they last, we will give one, free, to every engineer who fills out and mails the coupon. Send yours to-day.

How to Get the "Slide Valve," FREE

Fill out the Coupon, and mail it to us. We will address a book to you, and send it FREE of charge.

Your name ....

Address ....

Employed by ....

Address ....

Horsepower of Engine ....

Kind of Rod Packing Used ....

Do You Use **EBONITE Sheet Packing**..

Dealer's Name ....

Address ....

Who Buys Your Supplies? ....

.... Series

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.

629 Market St.

SMOKE MEANS WASTE

Apparent to all but the one most concerned

WASTE
SMITH Co
COAL BILL
He Runs A Gas Producer—But He Wastes The Gas
He Has His Sign Wrong—It's A Smoke Factory
Yes, There's A Fine Bunch Of Profits Going Up That Stack
I'm Glad We Don't Work Down Here. Think Of All That Soot
Suggested by M C Huyche
POWER

This cartoon—by "Power"—is self-explanatory; it is a showing of a "Manager" kicking about "Coal Bill" and ignoring the wasteful condition of boiler-plant equipment.

Smoke is a sure indication of waste of heat—money—value of coal fuel.

Determine 20 per cent. of your annual coal bill, and you will approximate the dividend-earning power of money investment required for **Murphy Automatic Smokeless Furnaces.**

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

Smoke Elimination Is Profitable

"A smoky chimney **does** mean a busy plant, but a smokeless chimney means one **just as busy,** with 12 to 15% higher efficiency from the coal used."

In hundreds of cases Jones Stokers have eliminated smoke and at the same time have so raised the efficiency of the boiler plant that a 15 to 25% saving has been effected.

Jones Underfeed Stokers are playing a leading part in the great smoke abatement crusade which is sweeping the Country—**and are paying a good big dividend to their purchasers** as well.

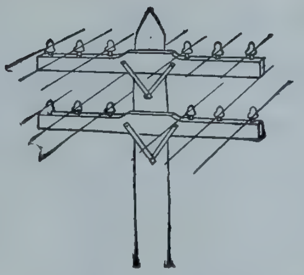
They will save money in your plant, too.

JONES UNDERFEED STOKER CO., LTD.

National Trust Building **TORONTO**

The advertiser would like to know where you saw his advertisement—tell him.

One Source
One Quality
for your
LINE MATERIAL



assures a lasting line and minimum maintenance — when that material is

Northern Electric

from pole to drop wires

The quality of Northern Electric line material is insured by rigid manufacturing specifications and inspection.

Service—an important item in your work—is assured by the large number of our distributing points—each one carrying large stocks for rush orders.

Consider this—then let us quote you on Poles, Cross Arms, Pins, Brackets, Insulators, Wire, Cable, Strand Guy Rods, Pole Hardware and Tools.

Northern Electric Company
LIMITED

Montreal	**Winnipeg**	**Edmonton**
Toronto	**Regina**	**Vancouver**
Halifax	**Calgary**	**Victoria**

LEARN THE OSTER STORY

The New Tool

Bull Dog Die Stock No. 81

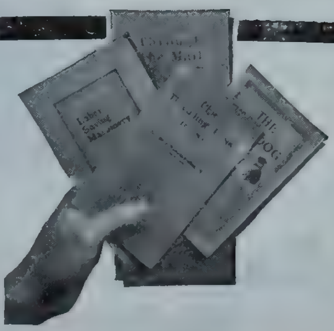
LEARN the wonderful simplicity of this new PIPE-THREADING TOOL; its strong, entirely self-contained construction; its compact design, **without loose parts;** its convenient lever-control. It is only one of the famous 47

OSTER TOOLS

Remember: "It's Easy To Get An Oster." In Canada there are 28 cities that have Oster supply houses. Ask us for this list. Note how closely it puts you in touch with Oster Tools. Ask us now for the nearest dealer's name, also the four booklets below. They tell you the Oster story. They show you **why** these famous tools are considered, the world over, **the standard equipment.** We have **proved** that in the end **Quality** is **Economy.**

28 Cities in Canada have Oster Jobbers

The Oster Mfg Co.
2099 E. 61st St.
CLEVELAND, O., U. S. A.



Kindly send me nearest dealer's name and the four booklets, "The Bulldog Tale," "Through the Mail," "List 28" and "Labor-Saving Machinery."

Name ....

Business ....

Address ....

City ....

Province 2099

"Columbia" Recording Thermometer

For any temperature range not over 1000 deg. F.

With popular "Day and Night" border chart—uniformly graduated.

With new, patented removable recording pen arm—chart changing made easy

With new, patented **insulated** covering for **steel** connecting tubing.

Mercury actuated — steel construction.

Accurate and durable.

Instruments for Power Plant Testing

ARE you running YOUR Boiler Room—YOUR Engine Room—or the Power Plant under YOUR control on a "maximum of efficiency with minimum expense" basis? If not, you are not working for the interests of your Boss—and incidentally not for your own interests.

Of course, to run things on a systematic basis, you must have proper testing instruments. That is where we come into the story.

Since 1850—nearly 63 years ago—the House of Schaeffer & Budenberg have manufactured "Instruments for Power Plant Testing"—Instruments of Quality and Precision. And with the knowledge accumulated during this time, we have maintained a SERVICE DEPARTMENT to solve YOUR problems.

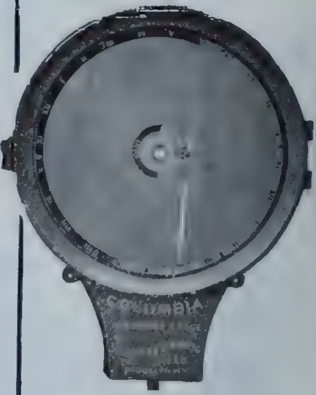
Our Catalogs and Our Service

You should have a set of our catalogs. They are mighty interesting and very instructive. Why not write for a set NOW? And while you are writing, think—isn't there some problem we can solve for you? Tell us your troubles—we can help you. **It costs nothing.**

The
Schaeffer & Budenberg Mfg. Co.
Makers of
Gauges, Tachometers, Indicators, Thermometers, Calorimeters, Counters, etc., etc.
Brooklyn, New York

161

"Columbia" Recording Gauge



For any range of pressure or vacuum.

With popular "Day and Night" border chart.

With new, patented removable recording pen arm—chart changing made easy.

Mechanically perfect—rugged in construction.

Accurate and durable.

KERR GATE VALVES

OUTSIDE SCREW AND YOKE

"KEYSTONE" PATTERN

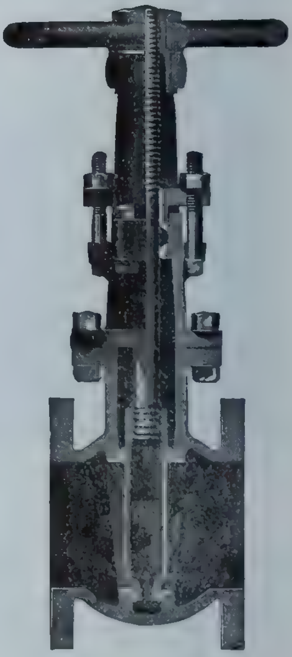
Embody all the latest features

4½-in. and larger

- Screwed-in Seats
- Deep Bronze Bushed Gland and Stuffing Boxes.
- Full Opening.
- Large Diameter Hand-Wheels.
- Solid Wedge Discs.

4-in. and smaller

- Narrow face-to-face Dimensions
- Symmetrical Design.
- Good Material.
- Interchangeable Parts.
- Guaranteed Tested.



4½-in. and larger

The Kerr Engine Co., Limited, MANUFACTURERS
Walkerville, Ontario

The advertiser would like to know where you saw his advertisement—tell him.

What J-M Boiler Preservative Will Do

It will remove scale already formed in a boiler.
It will prevent more scale from forming.
It will prevent the formation of scale in any water, in any locality, and under any temperature.
It will stop pitting and corrosion.
It will prevent injury to boilers from water containing sulphur.
It will remove oil and grease.
It will stop minor leaks in boilers.

What It Will Not Do

It will not injure iron.
It will not evaporate from boiler.
It will not affect the engine packing or lubricants or the products of a plant which may come in contact with the steam.
It will not cause boiler to foam or prime.
It will not cause any kind of trouble.

Send for Free Trial—

It Must Remove Old Scale and Prevent New Scale or it Costs You Nothing

We will send you one drum of J-M Boiler Preservative for a 60-days' trial. If it does not do as claimed when used according to directions, we will make no charge.

J-M BOILER PRESERVATIVE

is different from others—its action is mechanical and natural, as well as chemical.

J-M Boiler Preservative is attracted to the plates and tubes of a boiler—gets under the scale and loosens it, so that the scale is readily washed or blown out. It then forms a coating to which scale-forming elements will absolutely not adhere.

Our claims are based on experience. We cannot afford to injure the reputation we have built up in the last half-century.

Fill out the attached coupon and mail to our nearest Branch to-day.

THE CANADIAN
H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Boiler Preservative; Conduit; Metallic Hose; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners; Etc. 1730A

Toronto Montreal TRADE ASBESTOS MARK **Winnipeg Vancouver**

Fill Out, Cut Off on Line and Mail

Canadian H. W. J-M Co.

You may ship us via .... one drum of J-M Boiler Preservative for 60 days' trial in our plant. If we find that it does not do as claimed, you agree to make no charge for the quantity used in making test. We have....boilers. H.P. each.... Operate....hrs. per day.

Name ....
Street No. ....
Town .... Province ....

LUNKENHEIMER
SUPERIOR STEAM BOILER VALVES and FITTINGS

conform with Canadian Boiler Regulations, and are approved for use in Canadian Provinces, including British Columbia, Alberta, Saskatchewan and Ontario.

The line approved includes Globe, Angle, Cross, Check, Gate, Blow-off, Pop Safety, Relief, and Non-return Safety Boiler Stop Valves, Water Gauges, Gauge Cocks, etc.

A complete list of Official Registration Numbers covering the above will be sent upon request.

The supremacy of LUNKENHEIMER PRODUCTS is universally acknowledged, and to maintain this reputation, the highest type of skilled labor is employed, and only new material of the very highest grade is used.

We guarantee our goods to be of the very **highest quality**, and a LUNKENHEIMER GUARANTEE is a real, definite quantity, and not an empty use of the meaning of a guarantee.

All correspondence and inquiries receive prompt attention, and immediate shipments are insured, as large stocks are carried.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes, they are never as good as the genuine.

Write for catalogue, illustrating and describing the complete line of **Lunkenheimer High-Grade Products.**

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High-Grade
Engineering Specialties in the World.

Executive Offices and Factories: CINCINNATI, OHIO, U. S. A.

New York, 64-68 Fulton St.
Chicago, 188 N. Dearborn St.
Boston, 138 High St.
London, S. E., 35 Great Dover St.

Wheeler Condensers are celebrated throughout the world; the Wheeler Condenser and Engineering Company was one of the first companies to concentrate its entire energies on the design and manufacture of Steam Condensing machinery.

For Steam Engines, the simplest, most efficient and reliable outfit is a Wheeler-Admiralty Surface Condenser mounted over combined direct acting air and circulating pumps.

For Steam Turbines, the highest possible vacuum must be attained. Wheeler High Vacuum Surface Condensers are furnished with large capacity centrifugal circulating pumps and the Wheeler Edward Air pumps, The Wheeler Dry Air pump or the Wheeler Turbo Air Pump. **Vacuums of 28 to 29 inches and more are assured.**

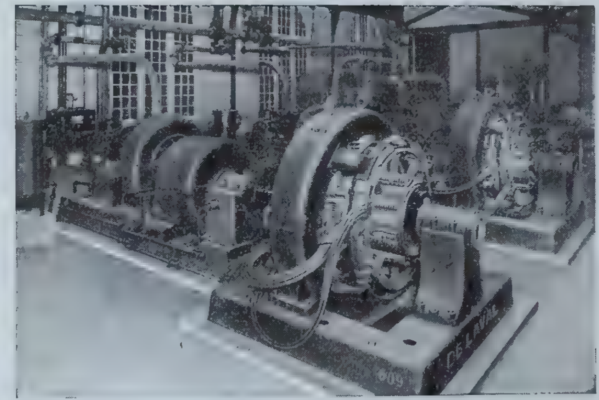
Wheeler Products include Wheeler Surface Condensers as outlined. Wheeler High Vacuum Jet Condensers, Wheeler Barometric Condensers, Wheeler Centrifugal Pumps, Wheeler Air Pumps, Wheeler Feed Water Heaters, Vacuum Pans and Multiple effects, Wheeler Barnard Forced Draft Cooling Towers, Wheeler Balcke Natural Draft Cooling Towers and other products.

ANNOUNCEMENT

The Wheeler Condenser and Engineering Company, Carteret, N.J., announces the opening of a branch office in

MONTREAL, QUEBEC
122 Board Trade Building
Mr. Jos. McKay, Jr., Mgr.

WHEELER
Condenser & Engineering Co.
The Pioneer Condenser Builders
Works: CARTERET, N.J., U.S.A.
Montreal, 122 Board Trade Building



The De Laval Multi-Stage Turbine

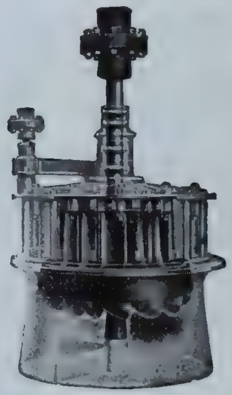
runs at the correct speed for high economy, and is of simple and reliable construction. It drives a standard slow-speed generator by means of a De Laval Reduction Gear.

The generator is a standard speed direct-current machine with ample commutator and brush area, and of the ordinary construction familiar to all operating men.

De Laval Multi-Stage Turbines are built for all capacities above 500 H.P., and for all steam conditions, such as high pressure condensing and non-condensing, low pressure and mixed flow service.

Write for catalog "D 61"

De Laval Steam Turbine Co.
TRENTON, N. J.



For All Water Power Purposes

If you have a water power you can use, the "Samson" wheel will develop that power most economically.

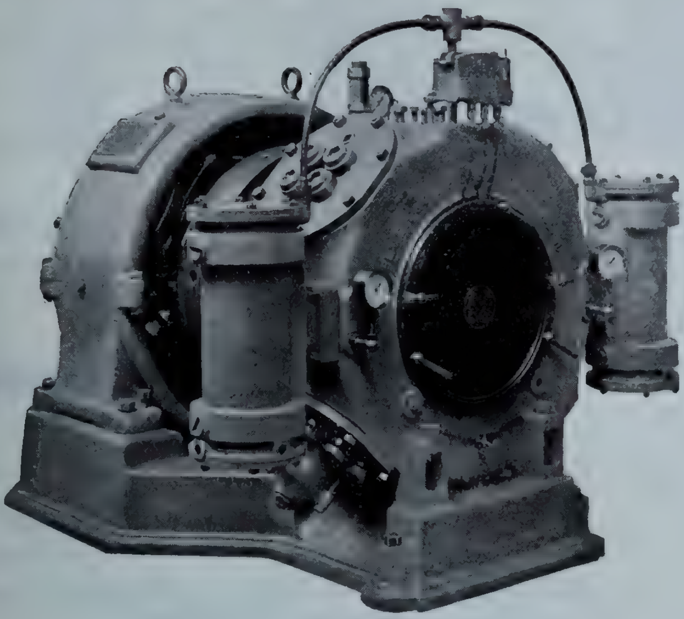
The high efficiency shown by this wheel in official tests proves its economy in the use of water, and shows what the wheel will do for you when working under your conditions.

It is easily installed, and when in operation is easily controlled.

The "Samson" is always sold on an absolute guarantee.

Send for Pamphlet V.

William Hamilton Company
Peterborough, Ontario



REAVELL
Air Compressors

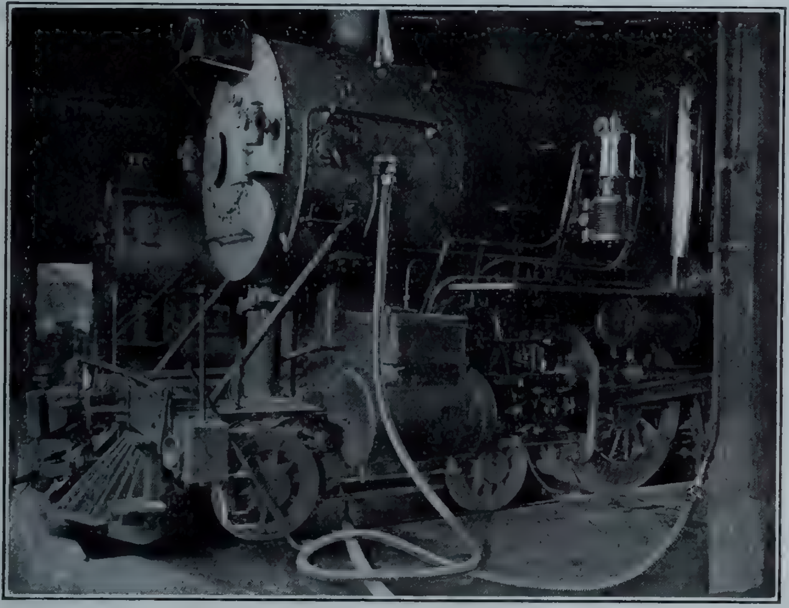
There are 7 of these Reavell Sets installed at the Toronto Street Railway Company's Barns.

CAPACITY EACH
414 cub. ft. 70 lbs. pressure.

Sub-Agents for Ontario:
W. A. Martin & Co., 70 Lombard St., Toronto

Sub-Agents for Quebec:
Rudel-Belnap Mach. Co., McGill Street, Montreal

CANADIAN BRITISH ENGINEERING CO., Ltd.
324 SMITH STREET, WINNIPEG, MAN.



Sprague Armoured Steam Hose in Round House Service

Sprague Armoured Hose

It is the only steel-protected hose at the present time which will satisfactorily meet all requirements of the air brake service. The flexibility is such that it prevents the hose troubles occurring on the automatic hose connector where the plain hose will not give satisfaction due to kinking, bursting or blowing off of fittings.

For further particulars send for Bulletin 521.

CANADIAN GENERAL ELECTRIC CO.
Limited

HEAD OFFICE - - - TORONTO

District Sales Offices:

Montreal Halifax Ottawa Fort William Winnipeg Calgary Vancouver Victoria
Cobalt Regina Edmonton Porcupine Saskatoon Nelson Prince Rupert

SIMPLEX SPECIALTIES FOR POWER PLANTS.

SIMPLEX PATENT

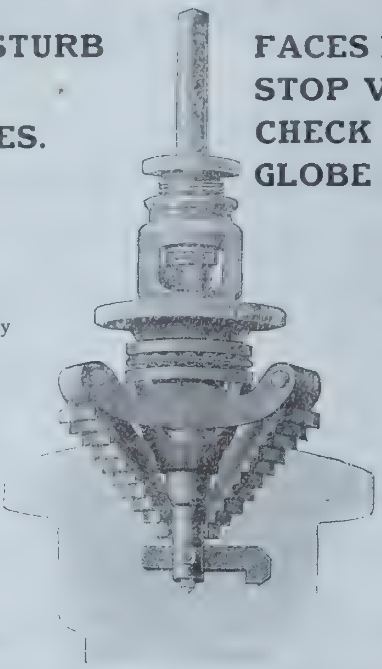
Valve Reseating Machine

DONT DISTURB
YOUR
PIPE LINES.

Made to do all Sizes to 12-inch.

We also Supply Attachment for Facing Valve Discs.

Stop Your Valves from Leaking!



FACES IN PLACE
STOP VALVES
CHECK VALVES
GLOBE VALVES

Specially Suitable for Babcock Check Valves.

Simplest Machine on Market

Simplex Self-Adjusting Flue Brush

Simplex Four-Arm Flue Scraper

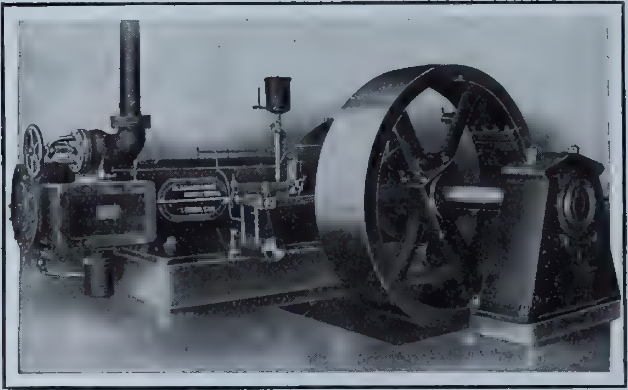
Condenser Tube Brushes, Scrapers and Scaling Machines,

Boiler Tube Extractors, Etc.

Agents—
Geo. H. Tod, Toronto; Geo. H. Tod Co., Winnipeg; Western Supply & Equipment Co., Calgary; W. Poole Dryer Co., Ltd., Vancouver; Maysmith & Lowe, Ltd., Victoria.

WRITE FOR LISTS

BROMELL PATENTS CO., LIMITED, 62 ROBERTSON STREET
GLASGOW - SCOTLAND.



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

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High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants

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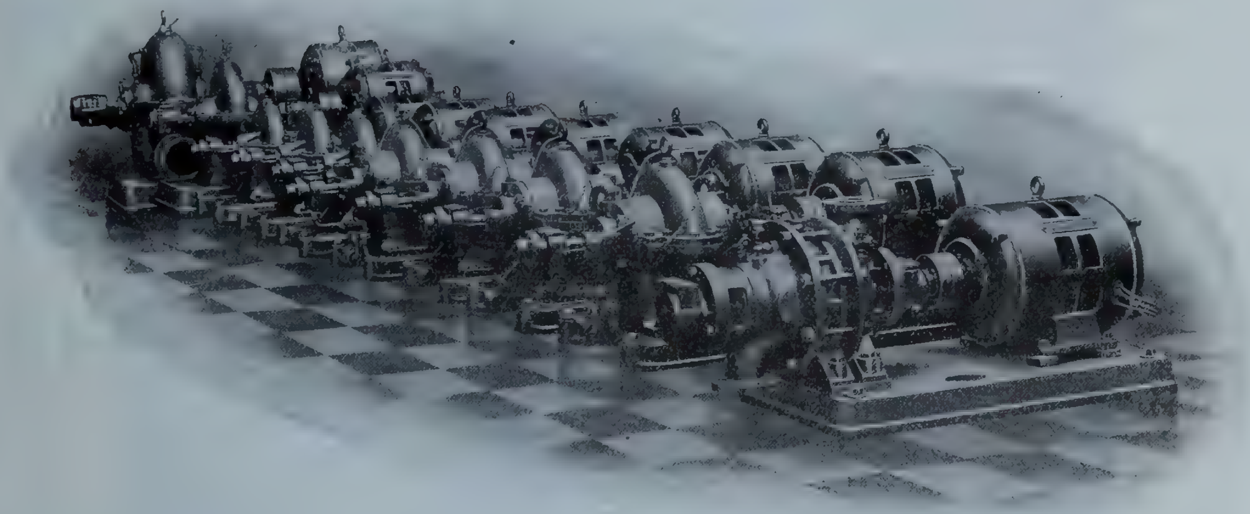

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Illustration shows ten "Conqueror" pumps for special digester, caustic liquor, main water and boiler feed purposes — for an Ontario Pulp Mill,

For prices and full particulars, apply to the head office at

BEDFORD, England

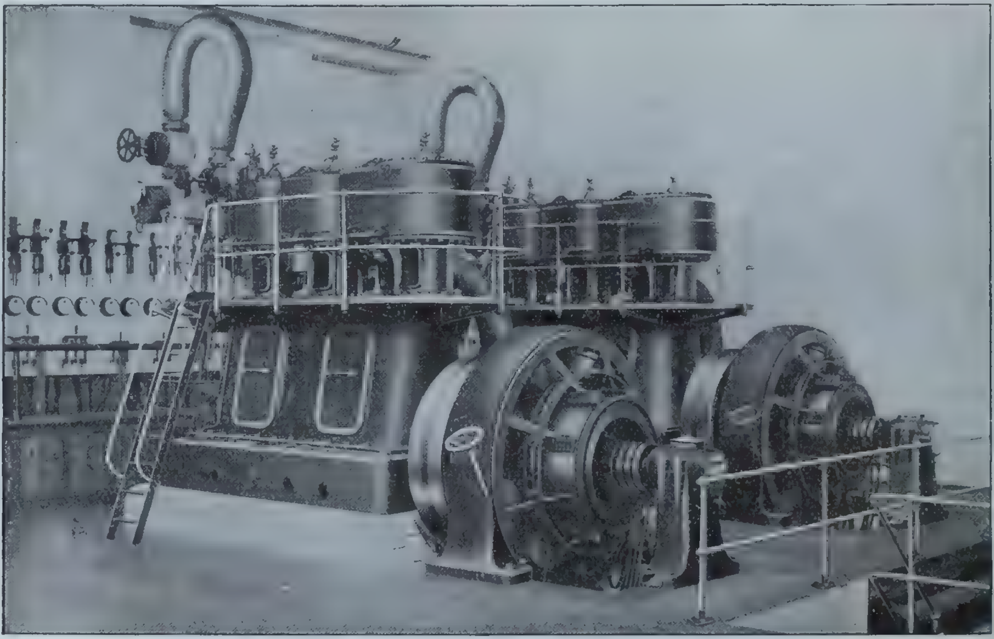
THE BELLISS ENGINE

THE HIGH-SPEED, DOUBLE-ACTING, FORCED-LUBRICATION ENGINE WAS ORIGINATED BY US IN 1890, AND SINCE THAT DATE WE HAVE ACTUALLY MANUFACTURED

5,000 ENGINES

REPRESENTING

1,000,000 HORSE POWER



600 H. P., 350 R. P. M., Belliss Triple Expansion Engine.

Two of the Above Type of Engines Recently Ordered for the Toronto Waterworks.

We have installed upwards of 150 Belliss Engines in Canada.

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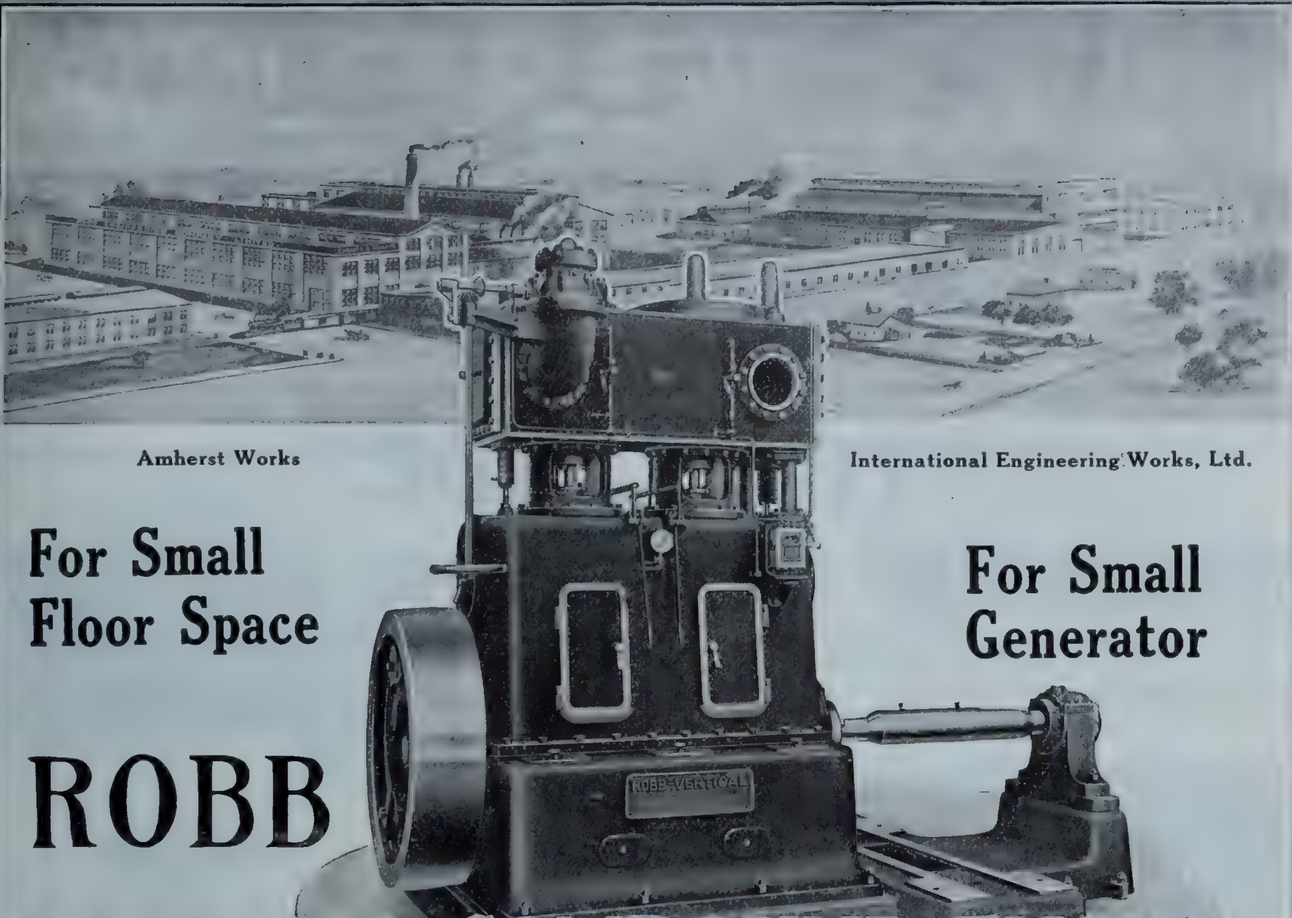

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International Engineering Works, Ltd.

For Small Floor Space

For Small Generator

ROBB VERTICAL COMPOUND ENGINE

High Speeds of Rotation with pistons of large diameter give a powerful engine in small space. The direct-connected generator can be of small diameter because of the high speed so that the unit will be of relatively low cost and small dimensions for a given kilowatt output.

Quiet and satisfactory operation at piston speeds of only 500 to 800 feet per minute make these engines particularly adapted to electric light plants and electric railway service—installations requiring high-grade durable engines which will operate under a great variety of load.

Long periods of operation without attention are made possible by the system of forced lubrication which supplies all bearings with an abundance of oil.

Complete enclosure of all moving parts prevents oil from flying about and protects the parts from accidental injury.

Low Steam Consumption is due to the very small clearances, high speed, automatic governing, and refinement in finish.

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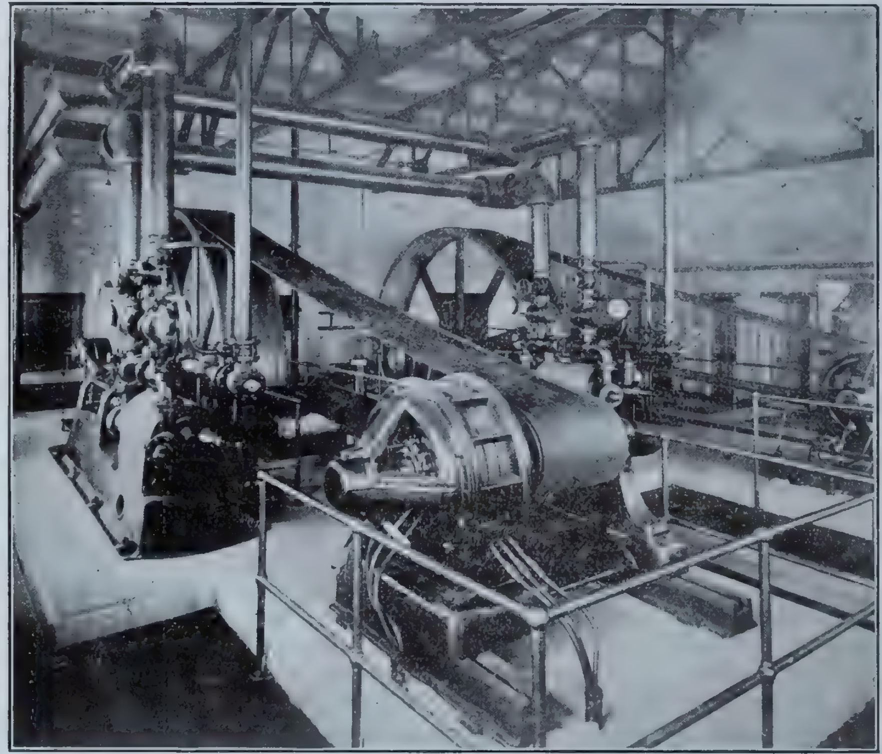
REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogues and estimates upon request.

The Linde Canadian Refrigeration Co.,
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Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

Bulletins sent on request.

The Vilter Mfg. Co.
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When It's Fitting Time

in an Ice-Making or Refrigerating Plant, the most important thing is to be able to get what you want when you want it.

When you can get good Valves and Fittings, and get them promptly, you have the ideal combination.

Ever try **YORK** service on **Valves, Fittings** and **Supplies?** Now is a good time to begin.

A complete line of our standard Valves and Fittings, of both the screwed and flanged types, is carried in stock by—

CANADIAN ICE MACHINE COMPANY
163-167 Yonge Street TORONTO
Branches :
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324 Coristine Bldg.
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YORK MANUFACTURING COMPANY

Ice-Making and Refrigerating Machinery Exclusively

YORK, PA.

EXCELSIOR AMMONIA CANADA'S BEST

CANADIAN AMMONIA CO., LIMITED

TORONTO, ONT.

ANHYDROUS AMMONIA

With a Reputation

LOOK FOR THIS TRADE-MARK 100% EFFICIENCY

THE POWER HOUSE

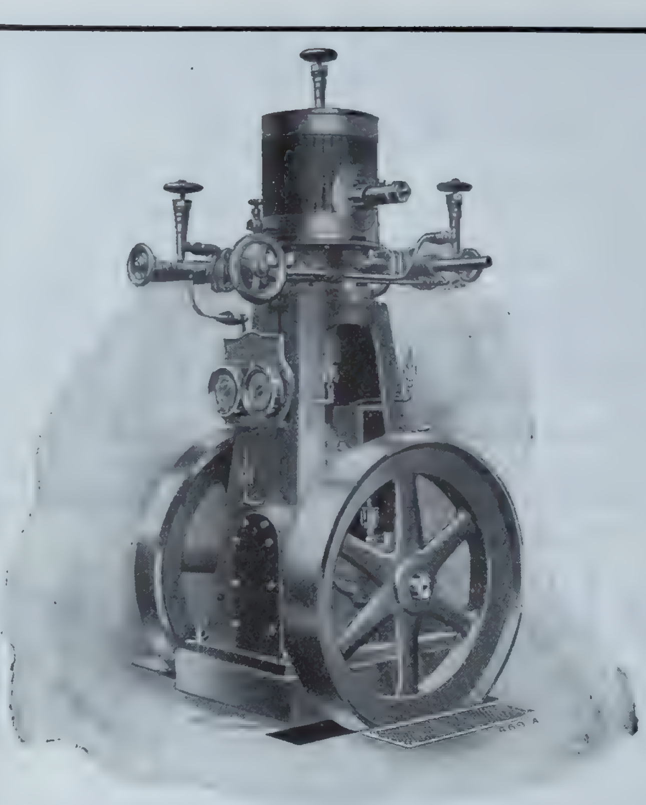
reaches—operating, superintending and consulting engineers in charge of steam, hydraulic and electrical power plants.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

The advertiser would like to know where you saw his advertisement—tell him.



The FRICK—

Friends insist it's the best
Enemies admit it's very good
Competitors claim to equal it

What other evidence could any one want of its being the best?

Get our directory of Users and look up a dozen in your own state.

Then you'll learn of its strength and reliability, its high efficiency and its very low upkeep cost.

Canadian Representatives
Keith's Limited
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FRICK COMPANY
Waynesboro, Pa., U. S. A.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name De La Vergne stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada

J. V. Jamison. President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

The Correct estimated value of

A Refrigerator Door and Window

—is service.

1st. Efficiency
2nd. Strength and Durability.

Jones Cold Store Door Co.

Hagerstown, Maryland

products combine and recommend to the trained and untrained eye, unexaggerated ability to perform its work and to stand up to its place. The construction object is in defiance to the

Slam Bang Laborers "Disable Me If You Can"

HINGES AND FASTENERS weigh 60 lbs. to the set. The Doors and Windows work as easy as the front Door on your dwelling.

They will not leak.

Refrigerator Doors and Frame and Windows mean shipped complete ready to set in the opening.

We guarantee our "AD" statements.

We believe a big part of our success is due to pleasing our Patrons.

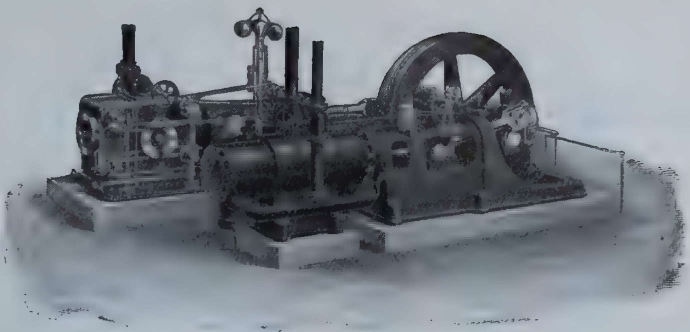
We are the sole manufacturers of the "NOEQUAL" DOOR with round jambs, so popular with the packing trade.

Our Revolving Ice Cream Door is a success for its purposes.

Our Ice Doors and Chutes do all that is required.

Jones Cold Store Door Co.

HAGERSTOWN, MD., U. S. A.



Arctic Ice Machines

in Canada

are creating sales wherever installed. Recently we placed in operation an Arctic Refrigerating Plant for the St. Regis Hotel, Winnipeg.

Next the St. Charles Hotel, Winnipeg, ordered a similar outfit.

We are now shipping an Arctic ice and refrigerating plant to the new Olympia Hotel, Winnipeg.

In ice factories, storage houses, etc., we can point to the same occurrence.

When an ice machine is its own best salesman—well, you want that kind.

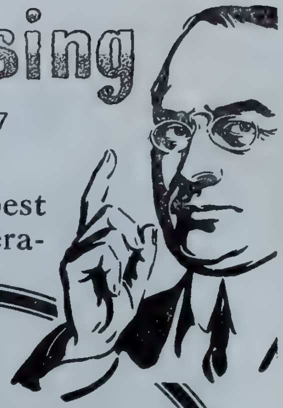
Sizes from one-ton refrigeration upward.

Bulletin 1-P on request.

THE ARCTIC ICE MACHINE CO.

CANTON, OHIO, U.S.A.

You're Losing Money



If you are not using the best insulation in your refrigeration plant.

You Can Stop That Loss At Once By Using Our

Corkboard Insulation

It is made of pure cork, and is recognized as the best insulation for cold storage and refrigerating purposes.

It is the only cork insulation that is made in Canada.

Write for full particulars.

Robinson Bros. Cork Co., LIMITED

HEAD OFFICE—803 LUMSDEN BLDG. TORONTO

FACTORY—
PORT COLBORNE, ONTARIO

This 100-ton "Safety" installed at Fowler's Canadian Company, Hamilton, Ontario.

SUMMER ICE

Mr. Ice Machine User—Are you fully prepared for the coming summer months?

Has your plant been gone over thoroughly and made safe against every extraordinary demand?

You ought to go over your entire plant now.

Your requirements for new refrigerating and ice-making machinery can be met efficiently and economically with the "Safety."

"Safety" compressors are the best insurance against every shut-down you might otherwise experience.

Then remember that we have machines in stock which can be installed immediately and ready to operate before the summer ice season opens.

The Huetteman & Cramer Co.
Detroit Michigan

Take the Pulse Of Your Power Plant

The engine is the heart of your plant. Be sure that it is working at the proper speed. You can tell exactly

WITH A

Starrett Speed Indicator

It registers any speed without beating of the parts. The movements are enclosed like a watch. This indicator is equally good for motors, gas engines, shafting, or any revolving machine part. Rubber tips for centered or pointed shafts. Get the Starrett Catalog 20 C.D. It shows other tools for the engineer.

Starrett Tools are sold at all good hardware stores.

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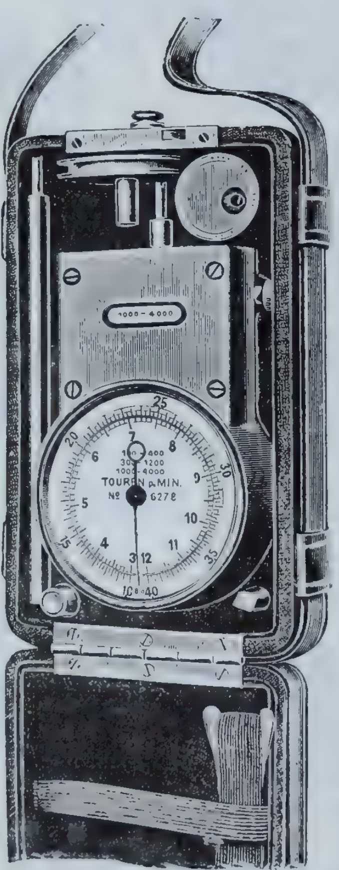

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(DR. HORN'S LATEST IMPROVED TYPE)

Excellent Quality —Moderate Prices

Hand and Stationary Instruments Suitable for all Purposes.

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Exceedingly Sensitive, Will Record the Slightest Change in Speed of Machine.

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A Revolution Counter and Centre Second Stop Watch Combined to Operate Simultaneously.

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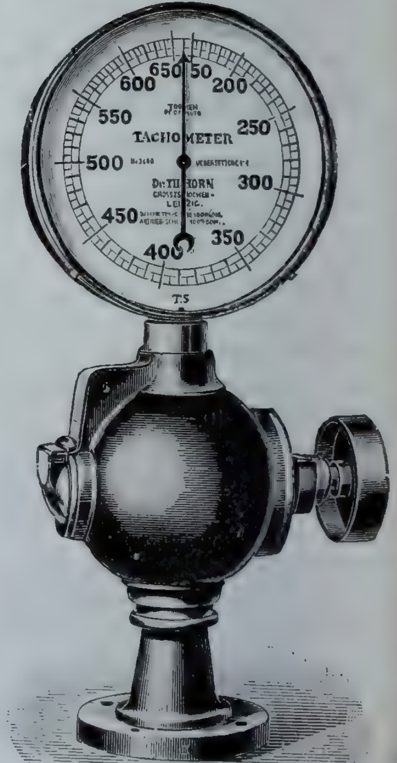


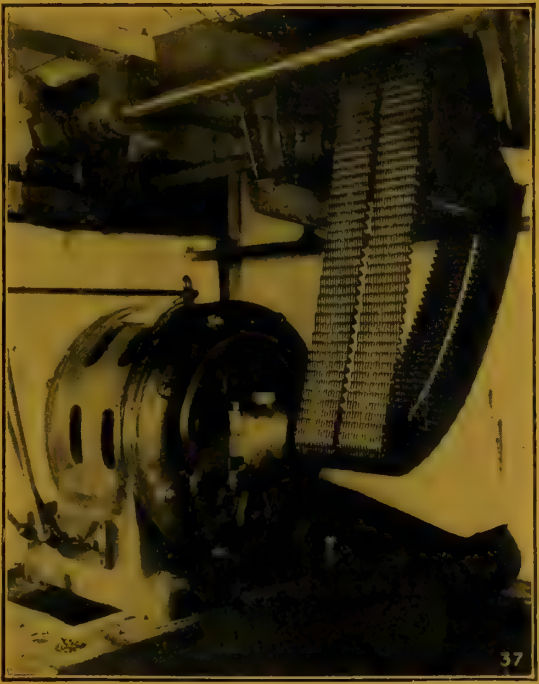
HANS RENOLD PATENT LINER SILENT CHAINS

(Hans Renold Limited are the oldest and largest manufacturers of Steel Driving Chains in the world.)

Not only provide the most efficient system of power transmission but the

"PATENT LINER JOINT"

ensures the maximum durability with minimum up-keep costs.



A 100 H.P. single reduction silent chain drive in a prominent Canadian plant. This drive replaced a double reduction belt drive three years ago, and although it has been in operation 144 hours per week continuously, there have been absolutely no repairs or maintenance charges. **Repeat orders from same company are best evidence of satisfaction.**

Jones & Glassco
(Reg'd.)
SOLE CANADIAN AGENTS
St. Nicholas Building,
MONTREAL
Branch Office : TORONTO

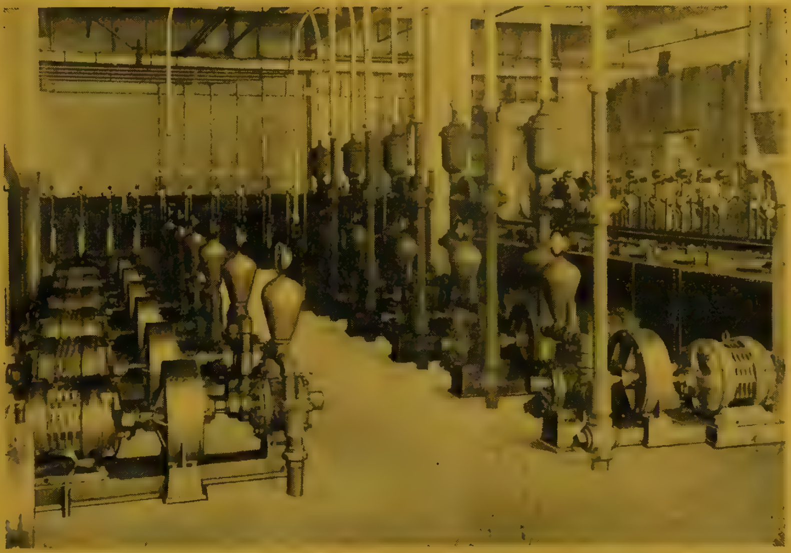
Write for particulars
and catalogues

Where Oil Efficiency and Economy Spell Dollars

When concerns like the Indiana Steel Co., National Core Co., National Cash Register Co., Singer Mfg. Co., Westinghouse Elec. & Mfg. Co., etc., use

BOWSER
ESTABLISHED 1885

Systems for safe, convenient and economical handling of lubricants, paint oils, varnishes, etc., it is because they are *Money Savers.*



One small part of Bowser Equipment as installed in the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

From 50 to 14½ Gallons Per Month

There's a sample of Bowser saving in New York City. Bowser can give you hundreds of other just such instances elsewhere.

And Bowser can show you just how this same economy and efficiency can be applied in *your* plant.

Bowser Will Surprise You

Some power plant owners have said "It can't be done." Bowser has shown them where they were wrong.

Put your oil problems up to Bowser—let him assist you in getting a full dollar's worth of service from every dollar's worth of oil—how to use the same oil over and over again—how at "heaviest load" seasons, to make every engine and machine work "at normal" because of *increased oil efficiency.*

Accuracy Compellers

But what is more, learn how Bowser systems *compel* accuracy, economy, tidiness, efficiency, safety, where your oil is concerned. No charge for asking. For twenty-nine years Bowser has been solving oil storage problems.

To get something of the Bowser scope write for the Bowser Oil Filtering Book. Ask questions. No obligation.

S. F. Bowser & Company, Inc.
32-73 Frazer Avenue, Toronto, Ont.
Engineers and Manufacturers of Oil Handling Devices
Sales Offices in all Centers and Representatives Everywhere

SAVE 50%

By Using
GREASE AS A LUBRICANT
In The

"PHILADELPHIA" GREASE CUP

Automatic Feed Under Compressed Air

Slow And Continuous

No Oil Drips—Reduced Fire Hazard

Unexcelled for Lubricating Loose Pulleys, Crank Pins and all classes of Extremely High Speed and Heavy Running Machinery.

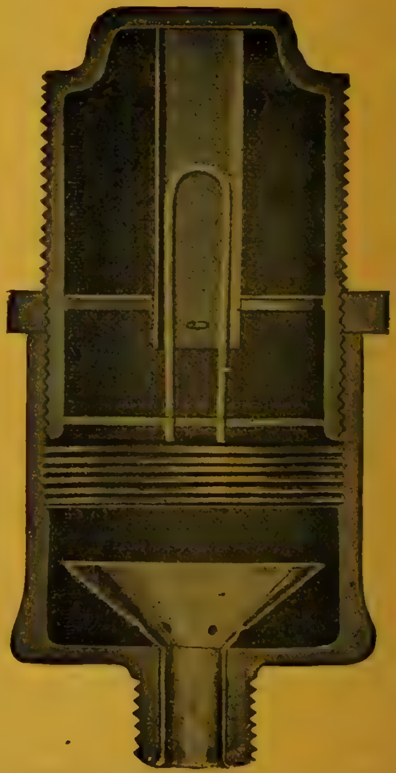
In the "Philadelphia" Grease Cup System of lubricating there is no friction, no piston or spring is used, just a thin metal disc resting lightly on the grease to keep it level.

Air pressure above and the needs of the journal below are all that is required to give perfect lubrication. Grease does not change in the slightest, while in the **"Philadelphia" Cup**, the last drop is as good as the first.

There is a large unrestricted outlet and a regularity of action which permits feeding of grease of any thickness.

We guarantee a saving of at least 50% over any other system. You must be perfectly satisfied before you pay a cent.

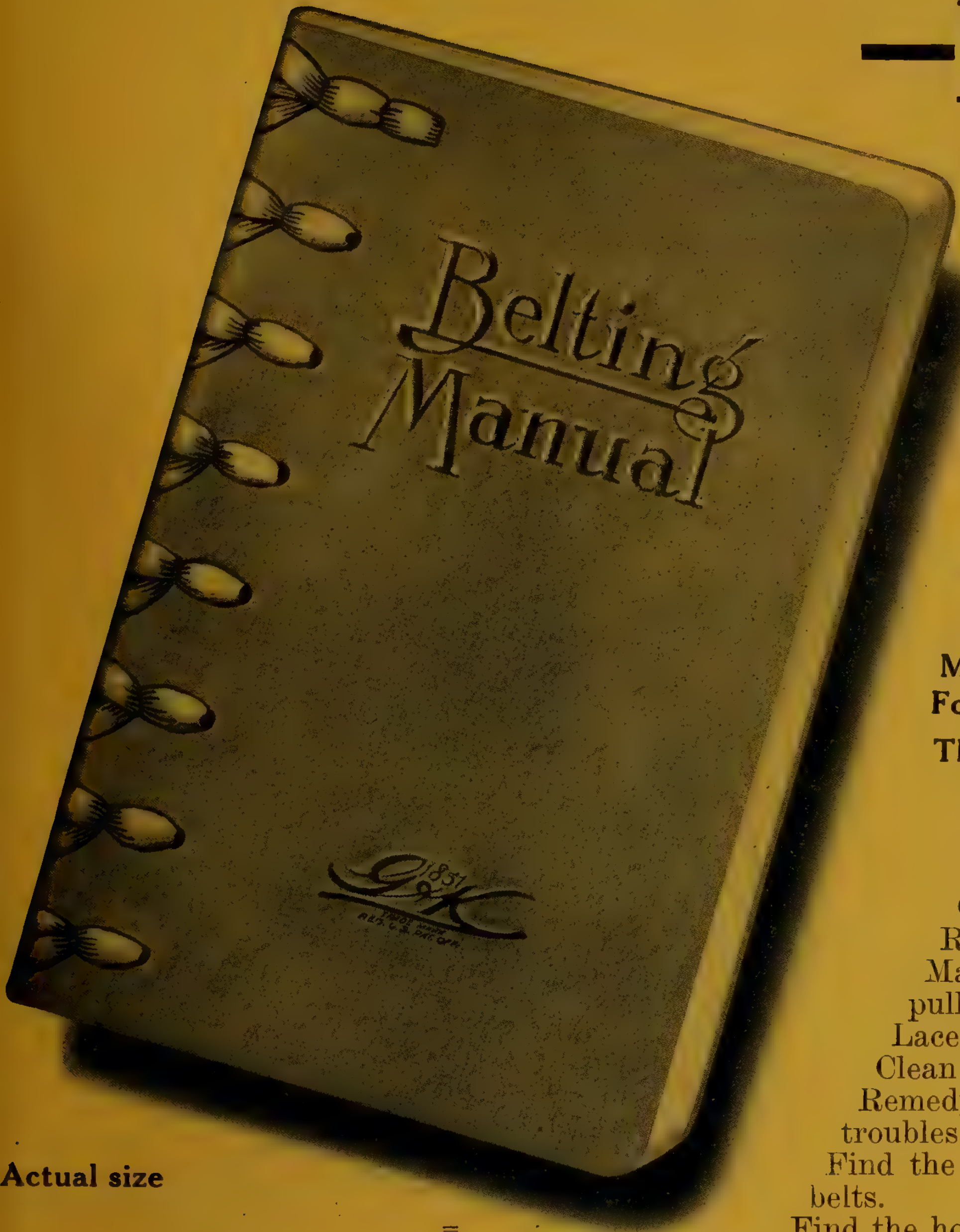
Our Booklet tells more about it — write to-day.



Peterborough Machine and Lubricator Co., Limited

PETERBOROUGH, ONTARIO

—It's Free



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G&K 1851
TRADE MARK

Cut out this coupon, stick it to a postcard and mail.

The Graton & Knight Manufacturing Co.
Unity Bldg., 46 St. Alexander St., Montreal, P.Q.

Gentlemen,
Please send your book "Belting Manual."

Name ....
Address ....
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Position......................
Company.......................
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Should be read by Buyers, Managers, Superintendents, Foremen and Engineers

The "BELTING MANUAL" fresh from the press tells how to:—

Install belting.
Care for belting.
Repair laps.
Make belts endless on the pulleys.
Lace belts.
Clean belts.
Remedy some of the belt troubles.
Find the widths and lengths of belts.
Find the horse-power of belting.
Find the speed of belting.

The fifteen pages of mechanical rules and tables are unusually complete and compiled expressly for use in solving the daily problems of Power Plant practice.

In short, the "Belting Manual" is a veritable fund of practical belting information—the latest and most authentic book of its kind.

Just take a minute to send the Coupon—to-day.

The Graton & Knight Mfg. Co.

Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, P.Q.

Home Office and Factory: Worcester, Mass., U.S.A.

NOTE:—Our "Educational Talk" which was scheduled for the April issue of this publication will appear in the May number. Subject—Progress Made in the Manufacture of Leather Belting.

Hold it to the belt a few seconds and all slipping stops

STEPHENSON
BAR BELT DRESSING

Doesn't require preparation nor any special care in applying---and it eliminates waste, slop and smearing on of paste or pouring on of spattering liquid.

And the results are better.

Red Label for Leather Belts, Green Label for Rubber, Canvas, or Balata Belts

You want a raise in salary—Stephenson Bar Belt Dressing will get it for you if your employer is at all grateful for your suggesting its use and the money it saves.

And besides it **will save you much trouble and make your work much easier.**

None Genuine without Trade-Mark.

Stephenson Manufacturing Co.
Albany, N.Y.

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.

We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.
Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me free of charge a half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....

WHAT CLING-SURFACE IS

A 12-inch laminated belt driving an air compressor in John Bertram & Sons plant (also the Canadian plant of Pratt & Whitney). Although the variation of load, sometimes sudden, between 25 and 82 horse power, makes this a severe test for Cling-Surface treatment, the belt had run for two years with 24 inches of sag under full load without slipping.

Driver pulley, 14-in. diameter, 765 revolutions per minute. Driven pulley, 5-foot diameter. Distance between shaft centres, 13 feet. Belt speed, 2,800 feet per minute.

Belts are made of perishable animal or vegetable fibre.

They are compelled to run in the hot, dry air of factories or damp air of other plants, at the speed of a locomotive, pull heavy loads under constant strain, bend back and forth many times per minute, and do their day's work.

What happens?

When they are new they do fairly good work, but soon they begin to dry out and polish. This causes slipping. The more they slip the more they polish, and sooner or later burn, and crack.

The two usual methods of preventing slip are: First, by tension (tight belts). Second, by putting on some sticky material.

The first way loads your belts, bearings, shafting and engine with a great dead drag of friction load. It is a most wasteful way.

The second way hurts your belts, dries them out, uses up power to rip the belt off the pulley and often forms lumps, on top of which the belt rides, with loss of contact and breaking the suction of belt on pulley. Also a wasteful way.

Both are poor ways.

Cling-Surface is a better one—the modern one.

Cling-Surface is a special, preservative food for leather and cotton belts, and also helps good rubber or balata. It contains no rosin nor other harmful ingredients, and is not sticky.

You feed Cling-Surface slowly to a leather or cotton belt, and it penetrates **into the body** of the belt itself, the pulleys force it in, the pores suck it in. It fills and surrounds every tiny fibre, inside and out, with its clean, neutral, lubricating food; so that these fibres work with their neighbors in little preservative, frictionless bearings—not the usual rubbing of dry fibre on fibre (and it does the same for ropes as for belts). It gives to the belt face a velvety softness and smoothness, while it makes the belt body elastic and flexible, mellow and healthy **all through.** The face is like the best new calfskin, giving absolutely perfect contact on the pulleys, while the body behind is in the best possible condition to follow and grip the pulley, because it is so flexible, firm and vigorous. And it stays so.

Such belts will never dry out, will never crack—you cannot make them stiff and dry.

They are fume-proof, water-proof, trouble-proof.

For rubber and balata belts it refreshes their surface, and gives them a better pulling face than they ever had, even when new.

This is what Cling-Surface is, and part of what it does.

The next page and the photographs herewith tell more of what it does.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street **Buffalo N Y**

New York **Atlanta** **Chicago** **Denver**
Boston **Memphis** **St Louis** **Toronto Etc**
London Thomas & Bishop 119-125 Finsbury Pavement

Cling-Surface
the life preserver for belts

WHAT CLING-SURFACE DOES AND WHO USES IT

"We have been using Cling Surface for about eight years, with most satisfactory results. Have used it for all kinds of drives. It lessens tension, increases efficiency and period of usefulness. Not a sign of slipping."
T. S. SIMMS & CO. Limited, St. John, N.B.
H. H. Reid, Sec'y. and Treas.

An excellent example of Cling-Surface results in the Canadian Rand Drill Company shops, Sherbrooke, Quebec. First treated with Cling-Surface in Jan., 1900. One year later, it had 20" slack, and to-day, over 11 years later, it is in perfect condition. No slipping.

GUELPH LIGHT & POWER DEPARTMENT, Guelph, Ontario. "This shows one of our main belts which has been treated with Cling-Surface for 8 years. No slipping. Cool bearings."
J. J. HEEG, Chief Engineer.

We have told you what Cling-Surface is, and that it puts and keeps the belt in mellow, flexible vigor, so that the whole belt lies close down to the pulley face and the whole belt takes the strain of the load. Cling-Surface keeps the belt in such condition that it can do its best work and last.

Then it makes it work by stopping all slipping. It stops the slipping better than tension does, and the tension is not necessary for this purpose. A belt which does not slip does not have to be run tight, but can be run slack, and the slacker it runs the more of the pulley it wraps. The greater the pulley contact the greater transmitting capacity the belt has.

By preserving your belts and preventing their slipping you have then secured the two essentials of perfect belt service. As a result, many economies are possible and must follow:

First: Increased power. Power which was lost in overcoming friction produced by belt tension is compelled to produce *output*, while no power is lost in slipping. Your machines run faster and more evenly.

Second: Oil. Slack belts tremendously reduce friction on bearings, and less oil is required. No hot boxes.

Third: Lacing. When belts do not have to be tightened, the amount and cost of lacings is greatly reduced, while the laced leather lasts longer.

Fourth: Fuel. Fuel is saved because the friction load is reduced with slack-running belts.

Fifth: Time and repairs. Time used and money spent in belt tightening and repairs is greatly lessened. What is even more important, expensive help and valuable machines need not stand idle while such repairs are being made.

Sixth: Worry. Cling-Surface-treated belts are dependable. They are always in condition to do their work, and can be trusted when a rush job and peak loads come on. That source of worry is done with.

Cling-Surface has been used by the best concerns in Canada for nearly a generation, and its value has long been established. By not using it you are losing what for years has proven profitable to others.

Among such concerns are: Massey-Harris Co.; Waterous Engine Works; Crossen Car Co.; Toronto Paper Mfg. Co.; Canadian Westinghouse Co.; Dominion Canners; Sawyer & Massey Co.; Steel Co. of Canada; Mickle, Dyment & Son; McCormick Mfg. Co.; Canada Iron Corp.; Canada Sugar Refining Co.; American Cyanamid Co.; Canadian General Electric Co.; Algoma Steel Co.; Frost & Wood Co.; Dominion Sewer Pipe Co.; Gurney Foundry Co.; Gerhard Heintzman, Ltd.; Hiram Walker & Sons, Ltd.; Canadian Pacific R. R.; Grand Trunk R. R., etc.

These concerns and many more know and use Cling-Surface. You will not know its value until you have tested it.

We are ready to ship you a package on approval and guarantee results to be satisfactory to you in every respect. Plants in the North-West can buy Cling-Surface locally if they will ask us the nearest point of stock.

Write us now for such a trial lot.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street **Buffalo N Y**
New York Atlanta Chicago Denver
Boston Memphis St Louis Toronto Etc
London Thomas & Bishop 119-125 Finsbury Pavement

Cling-Surface
the life preserver for belts

BOND

"Double Sure" Transmission

Ask your dealer. He has it, and will recommend it.

ALL BEARINGS
BABBITTED and
REAMED

The "Bond" Patent Universal Ring Oiling Ball and Socket Holder

Power
Transmitting
Machinery

Manufactured by
CANADIAN BOND HANGER
AND COUPLING COMPANY
(Limited)

Toronto Branch:
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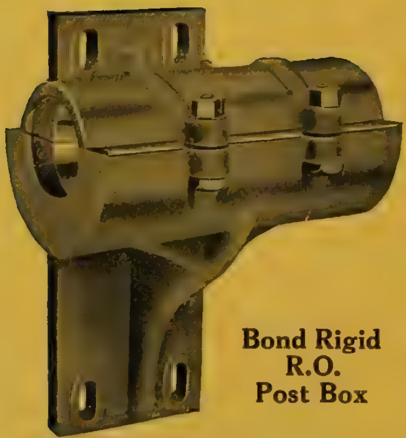
ALEXANDRIA
ONTARIO

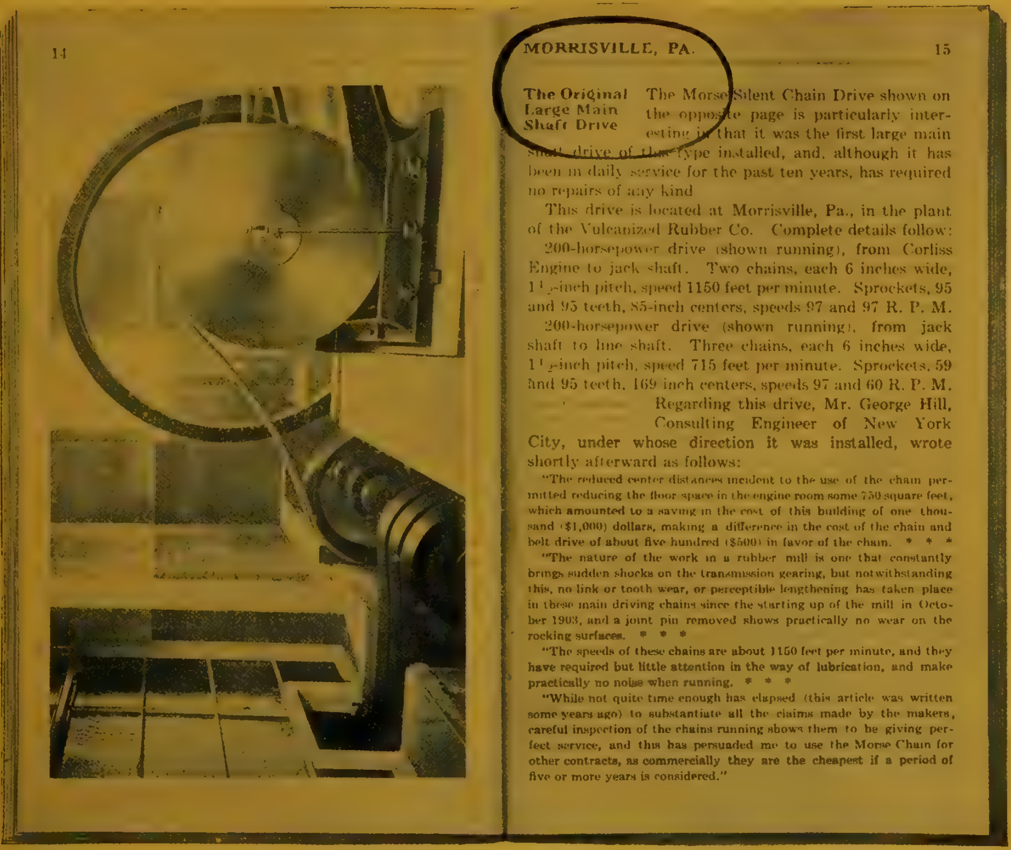
This Catalog Shows Complete Line. Write For It To-Day



Bond Rigid R.O. Post Box

The "Bond" Patent Spiro Compression Coupling
50% more gripping force than any other Compression Coupling.

Plate Coupling



14

MORRISVILLE, PA. 15

The Original Large Main Shaft Drive The Morse Silent Chain Drive shown on the opposite page is particularly interesting in that it was the first large main shaft drive of this type installed, and, although it has been in daily service for the past ten years, has required no repairs of any kind

This drive is located at Morrisville, Pa., in the plant of the Vulcanized Rubber Co. Complete details follow:

200-horsepower drive (shown running), from Corliss Engine to jack shaft. Two chains, each 6 inches wide, 1½-inch pitch, speed 1150 feet per minute. Sprockets, 95 and 95 teeth, 85-inch centers, speeds 97 and 97 R. P. M.

200-horsepower drive (shown running), from jack shaft to line shaft. Three chains, each 6 inches wide, 1½-inch pitch, speed 715 feet per minute. Sprockets, 59 and 95 teeth, 169 inch centers, speeds 97 and 60 R. P. M.

Regarding this drive, Mr. George Hill, Consulting Engineer of New York City, under whose direction it was installed, wrote shortly afterward as follows:

"The reduced center distances incident to the use of the chain permitted reducing the floor space in the engine room some 750 square feet, which amounted to a saving in the cost of this building of one thousand ($1,000) dollars, making a difference in the cost of the chain and belt drive of about five hundred ($500) in favor of the chain. * * *

"The nature of the work in a rubber mill is one that constantly brings sudden shocks on the transmission gearing, but notwithstanding this, no link or tooth wear, or perceptible lengthening has taken place in these main driving chains since the starting up of the mill in October 1903, and a joint pin removed shows practically no wear on the rocking surfaces. * * *

"The speeds of these chains are about 1150 feet per minute, and they have required but little attention in the way of lubrication, and make practically no noise when running. * * *

"While not quite time enough has elapsed (this article was written some years ago) to substantiate all the claims made by the makers, careful inspection of the chains running shows them to be giving perfect service, and this has persuaded me to use the Morse Chain for other contracts, as commercially they are the cheapest if a period of five or more years is considered."

Morrisville, Pa.

"750 square feet reduction in floor space"
"$1000 saved in the cost of building"

by using

Morse Silent Chain Drives

Such is the initial record of the above 200 h.p. drive.

In the more than ten years of its service, the entire first cost has been saved in power alone three times over, yet the attendance cost has been minimum and the repair cost nil.

Your copy of Booklet 12-B, showing applications in many different fields, will be sent free on request, together with any special information desired regarding your own transmission problems.

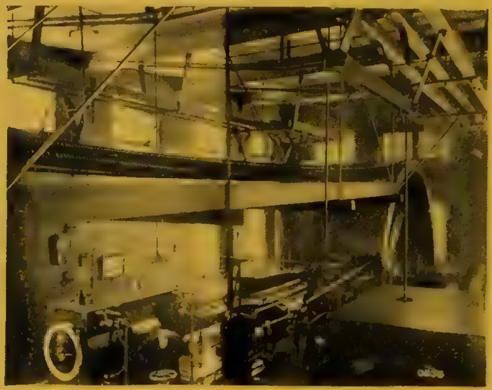
Let us figure out a probable saving in your plant.

Morse Chain Company, Ithaca, N.Y. B-11

A Simple Twist Tightens Any Rope

No. 95/26
Hunt Tension Adjusting Coupling spliced in the rope ready to put on the drive

If one of the bands on your multiple rope drive stretches, do you resort to the old-fashioned method of cutting out a piece of rope and resplicing it?



No. 0835.
1000-H.P. Rope Drive, equipped with Hunt Tension Coupling Bands.

All this is unnecessary if your drive is equipped with Hunt Tension Adjusting Coupling. A simple twist of the coupling tightens up any individual band and makes each rope do its share of the work.

If interested in learning more about these couplings and Hunt Stevedore Rope, with its unique system of internal lubrication that prevents wear and increases its efficiency, ask for a copy of our catalogue J 12.8 "Manila Rope." It contains 50 pages of information on rope drives for engineers.

C. W. HUNT CO., Inc.

West New Brighton, N.Y., U.S.A.

Fisher Bldg., Chicago. Evans Bldg., Washington.
45 Broadway, New York City

DURABLA

Registered Trademark Stamped all Over the Sheet

SHEET PACKING

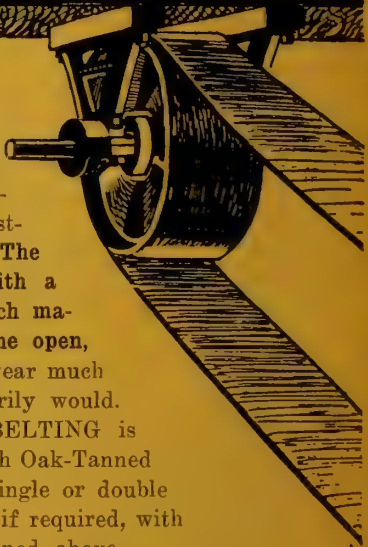
Increases efficiency; lessens amount of material used

Never fails! Never blows out!

Canadian Sales Agents
CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal, Ottawa, Calgary, St. John, Toronto, Saskatoon
Quebec, Winnipeg, Vancouver.

Manufactured by
DURABLA MANUFACTURING CO. NEW YORK

J.D.McArthur's LEATHER BELTING



Will Lower Your Transmission Cost

Our SAFFRON TANNED BELTING is especially valuable on fast-running machinery. The splices are stitched with a waxed thread lock-stitch machine—they cannot come open, and cause the belt to wear much longer than it ordinarily would. Our OAK-TANNED BELTING is made from Prime British Oak-Tanned Leather. Splices of single or double belting can be stitched, if required, with the machine as mentioned above. This splice and the high quality of our beltings mean that the buyer will effect big yearly savings.

Let us give you full particulars. Write!

J. D. McArthur & Company

Brockville, Ontario

How Much is Your Power Loss Annually?

In the big Canadian plants where *Efficiency* methods are being effectively employed to *check* leakages, this is the question that is being given the most *serious* consideration. Because it has been found that such losses—which in many instances reach *astounding figures* — are due, mainly, to *indifference* and lack of *care* in the selection of suitable belting.

Your Loss or Your Gain Depends Upon Your Belting

That is what gives importance to this—our message to you.

For over half a century we have been producing Rubber Beltings that have become the *standards* by which other beltings must be judged.

We have studied the power transmission question from every angle and brought to bear upon it the experience, brains and skill of our *experts*—familiar with actual working conditions—and the resources of *largest* and *best* equipped plant in Canada.

And we have produced four grades of Power Belting that are 100% efficient in *Reliability* and *Service* in Power Transmission.

"PARA" "KEEWATIN"

"LUMBER KING" "COLUMBIA"

These are the beltings used wherever *efficiency* is the first consideration—wherever Beltings are bought on their *merit*.

Every step in their manufacture is governed by the *prudence* and *experience* of a lifetime—plus the *unwavering* determination to produce beltings that would measure up to every *Service* test.

If You Are Not Getting the Service You Expected From the Beltings You Buy, Get in Touch With Us. We Can Help You—And We Know How.

WRITE OUR NEAREST BRANCH TO-DAY

We are Specialists in Beltings For Every Purpose.

Canadian Consolidated Rubber Co., Limited

Montreal

SALES BRANCHES: Halifax, ST. JOHN, Quebec, MONTREAL, Ottawa, TORONTO, Hamilton, London, Berlin, Brantford, North Bay, WINNIPEG, Regina, Saskatoon, Edmonton, Calgary, VANCOUVER, Victoria.

MAPLE LEAF

BRAND

Stitched Cotton Duck

BELTING

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing

The BEST for all kinds of belts

Dominion
Belting Co.
Limited

HAMILTON, CANADA

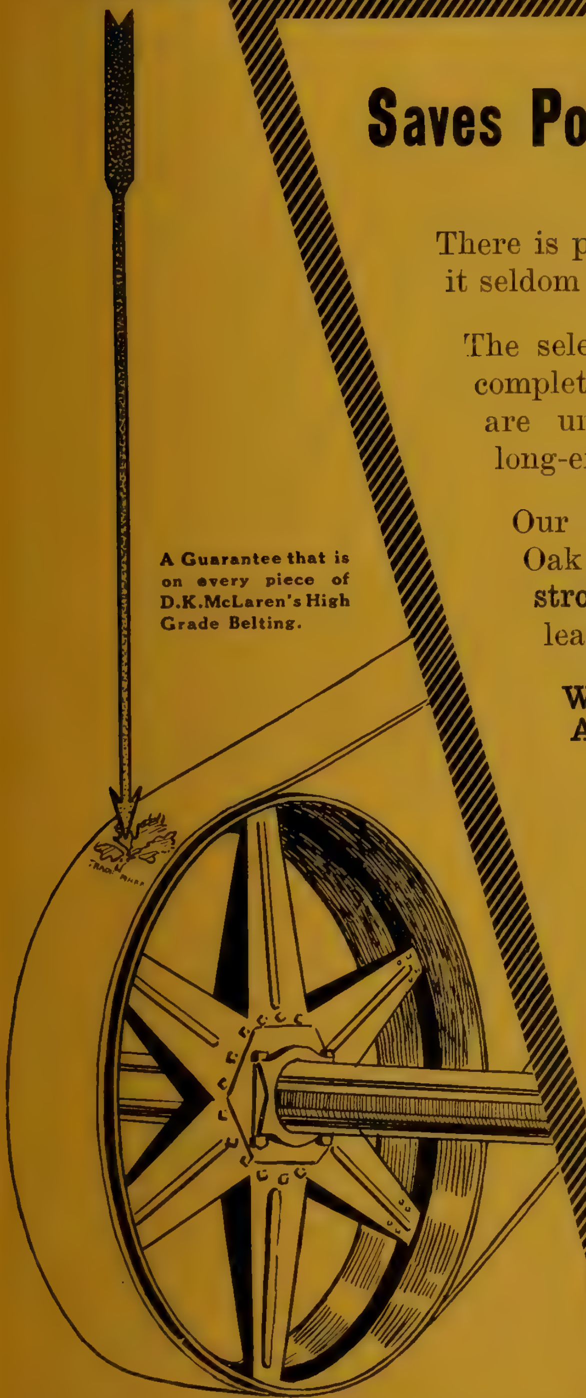
D.K.McLaren's

Genuine British Oak Tanned

Leather Belting

Genuine Oak

Genuine Oak


A Guarantee that is on every piece of D.K.McLaren's High Grade Belting.

Saves Power and Time

There is practically no slip, and it seldom requires tightening.

The selection of Hides and the complete manufacturing process are under the supervision of long-experienced Belt makers.

Our slow, old-fashioned British Oak Method of tanning assures **strong, tough, durable, pliable** leather.

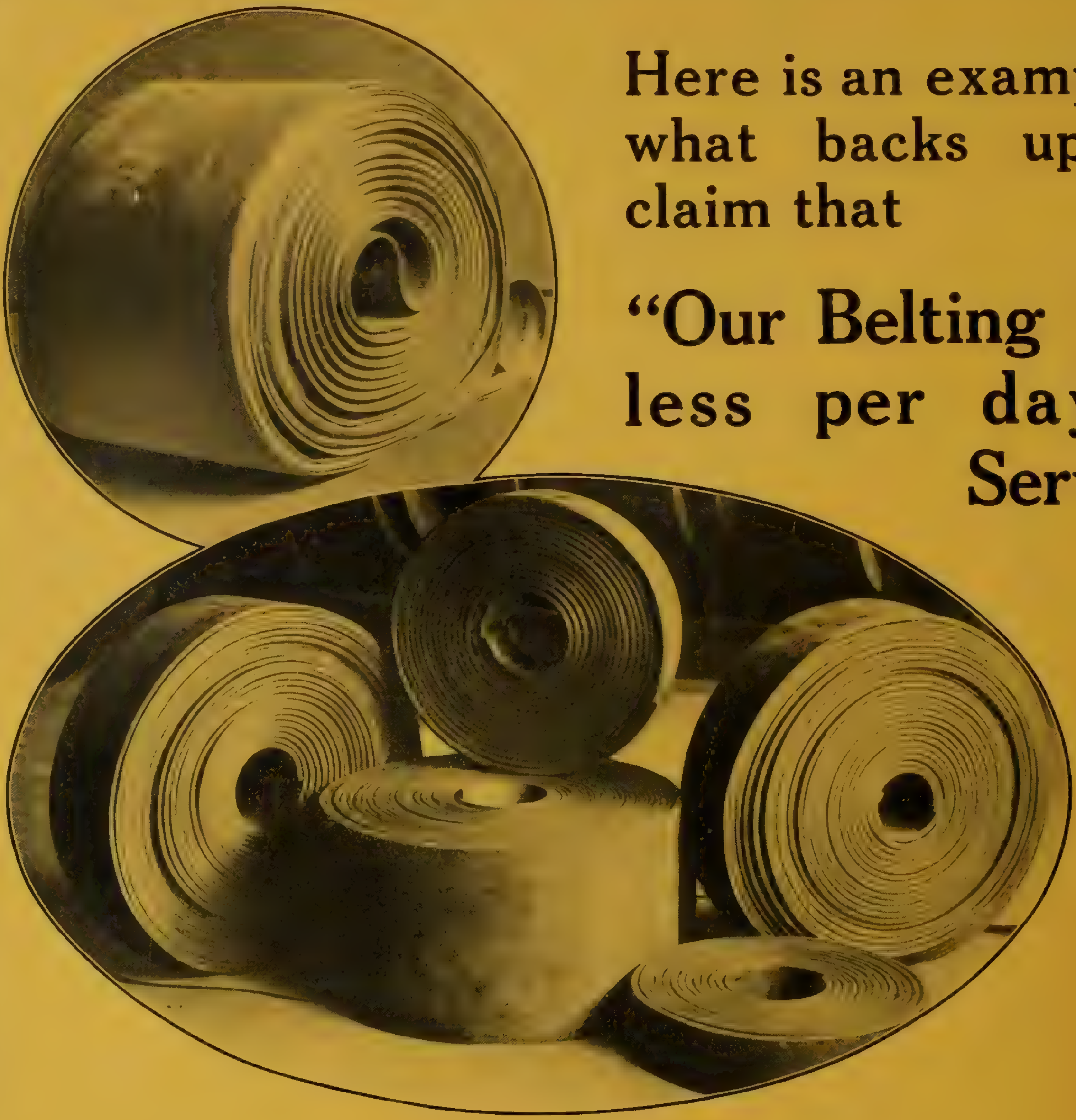
Want to Hear What Users Think About It?

We'll gladly get you in touch with a number of users at your request.

Why not write now? The experience of others will prove valuable to you.

D. K. McLaren Limited
351 St. James St., Montreal

Toronto	Vancouver	St. John, N.B.
200 King St. W.	847 Beatty St.	64 Prince William St.



Here is an example of what backs up our claim that

"Our Belting costs less per day of Service"

The big belt in the circle, a 24-inch double belt, 133 feet long, was bought from us in 1878—thirty-six years ago: since then it has been in continuous service, as the main drive in a flour mill. In October, 1913, after thirty-five years "on the job," a new belt replaced it, and the old belt was converted into the five smaller belts shown in the lower photo, one 12″ x 85 feet long; one 7″ x 98 feet long; one 6″ x 89 feet; one 4½″ x 50 feet; and one 4″ x 38 feet 10 inches. Service like this makes the first-cost-per-foot-length insignificant. SERVICE, and service ONLY, is the true criterion of belt value.

Facts, like the case cited above, prove the downright service in our belting.

Sadler & Haworth

Tanners and Manufacturers

For over 37 Years the Makers of the Best Leather Belts

MONTREAL: 511 William St. TORONTO: 38 Wellington St. E.
ST. JOHN, N.B.; 89 Prince William St. WINNIPEG: Galt Bldg.
VANCOUVER: B.C.; 216 Columbia Ave.

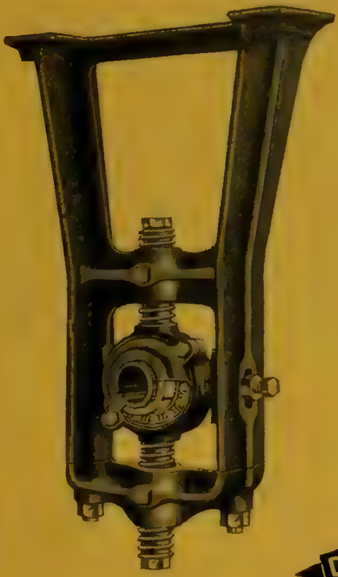
☞ To Ensure Satisfaction—State Where Belt is to Run

Transmission Appliances with a Reputation for delivering the power with Maximum Efficiency.

Universal Giant Hangers

alone combine absolute universal adjustment with symmetrical design and unusual strength, all requirements of a perfect hanger.

Large cast iron plungers make them self-adjusting and insure perfect alignment with the shaft.



Skefko "S.K.F." Ball Bearings

are the only absolutely self-aligning ball bearings made. They conform to the deflection of the shaft without binding. Maximum load-carrying capacity is secured by the double row of balls, which provide three balls at all times to carry the load.

Fairbanks Wood-Split Pulleys

The pulleys with the web built into the arm and rim, a feature which absolutely prevents the separating of the rims from the arms. The Rims are built up of segments of properly kiln-dried basswood.

Dick's Balata Belting

An ideal belt for all service; its stronger gripping powers insure positive transmission of the whole power. The saving in power thus secured will pay for the belt many times.

We carry in stock the most complete line of transmission supplies, steam goods, etc., in Canada.

The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Quebec Ottawa Toronto Hamilton Ft. William
Saskatoon Calgary Edmonton Winnipeg Regina Vancouver Victoria

Canada's Departmental House for Mechanical Goods

A Typical LEVIATHAN Main Drive, Installed at the Plant of The Riviere du Loup Pulp Co., 24 in. x 6 ply, 81 Feet in Length.

LEVIATHAN BELTING

Has been sold on a "make good" basis for over thirty years. If it hadn't made good we would have been out of business long ago. The fact that our business is progressing rapidly is ample proof of the merit of this belting.

With every belt we guarantee full value in service, dollar for dollar, horsepower for horsepower, and just as we have figured our tables of horsepower for the best results, just so in making the above statement, we not only expect to give equal service, but **better service, and more economically.**

THE REASONS WHY:

LEVIATHAN has far greater tractive power.

LEVIATHAN can be run much slacker than leather, thus putting less strain on the journals.

LEVIATHAN is not affected by atmospheric changes.

LEVIATHAN
ELEVATING
TRANSMITTING
CONVEYING
BELTING

Why not give us a trial order and let LEVIATHAN prove itself?

LEVIATHAN
ELEVATING
TRANSMITTING
CONVEYING
BELTING

Main Belting Co.
of Canada, Limited

MONTREAL
10½ St. Peter Street

TORONTO
24 Wellington St. West

How Do You Buy Belting?

Do you buy "just belting?"—or do you *invest* in the *service* that is to follow?

There's a big difference.

Belting bought on "price" alone is a poor investment. When trouble comes to such belting the first cost is increased by "idle machinery, repairs, salary for idle men, loss of output, etc."

Then, if you "keep tab" on your belts you will know just how much that "belt bought on price" has really cost you.

GOODYEAR

Belting For Every Purpose

Goodyear Belting solves all problems. We make 240 different sizes and kinds at our great Bowmanville plant.

Among them is just the particular belting for your particular needs.

Transmission

These are made for maximum power delivery. They cling to the pulleys so that slipping is practically eliminated.

Goodyear Belting cannot stretch. That is because all the "stretch" is taken up in course of manufacture. Hence no idle machinery due to slackened belts that must be "taken in."

The fabric used for the filler and warp of Goodyear Belting is best cotton duck. We test it in our laboratory like all other Goodyear materials. Only the strongest and best by actual test is selected for Goodyear Belting.

Conveyor and Elevator Belting

Goodyear Conveyor Belts are made strong enough to stand up under heaviest loads, and year in and year out constant service.

Goodyear Elevator Belts for ore and grain are made to carry the heaviest buckets.

Tell Us Your Belt Needs

Put your Belting problems up to Goodyear. This service is free. Let us tell you of just the Goodyear Belting for your very purpose—and why! We can save you money. Buying belting this way means maximum service—belt insurance.

The Goodyear Tire & Rubber Co. of Canada

Limited

Toronto ***Goodyear Service Goes Everywhere*** **Canada**

Single Arm Steel Split Pulley

Dodge Steel Split Pulleys

This is something new—and admittedly the most perfect Steel Split Pulley on the market.

Rims ¼ in. steel—cannot dent, bend or break.

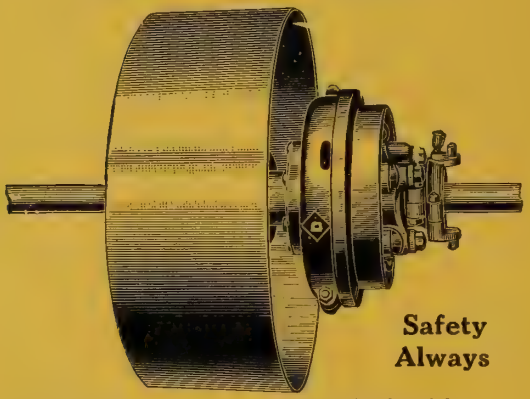
No grooves through centre to decrease belt adhesion. This seamless and beadless rim is strong and true running.

Arms support rim on either side of parting.

Order a sample pulley for comparison of quality and price.

Double Arm Steel Split Pulley

Dodge Friction Clutch



Safety Always

This Friction Clutch cuts off power in the nick of time—thus putting your men and machines on the safe side.

It can be put up or taken down without disturbing other equipment. Can be used as a cut-off coupling, for driving pulley or rope sheave, or for attachment to quill carrying a main driving wheel.

Can you afford to have machines idle while repairs are being made, or employees suing for damages on account of injury?

Full particulars in our "POWER TRANSMISSION ENGINEERING" CATALOG.

Dodge Hangers are smooth road-beds for power.

Dodge Bearings reduce friction because there is a true ball and socket connection between the bearing and the frame in Hangers and Pillow Blocks, which permits the bearing to freely align with the shaft.

Dodge Hangers and Pillow Blocks are furnished with ring or capillary self-oiling bearings, all lined with a high-grade metal, and BORED and REAMED. One filling of oil will last 3 to 6 months.

Full particulars in our "POWER TRANSMISSION ENGINEERING" CATALOG.

Ball and Socket Adjustable Hanger

To link yourself with

Dodge Products

is to ensure Highest Efficiency and Practical Economy

The Dodge line is one of proven merit. It speaks strongly for itself.
A trial is convincing.

Dodge Wood Split Pulleys

Are balanced and run true. Result of selected, seasoned, kiln-dried stock, combined with skilled workmanship and twenty-seven years of "knowing how."

Over a million in successful operation, and the output each year is greater than the year before.

Nailed and Dovetailed.

Dodge Manufacturing Co., Ltd.

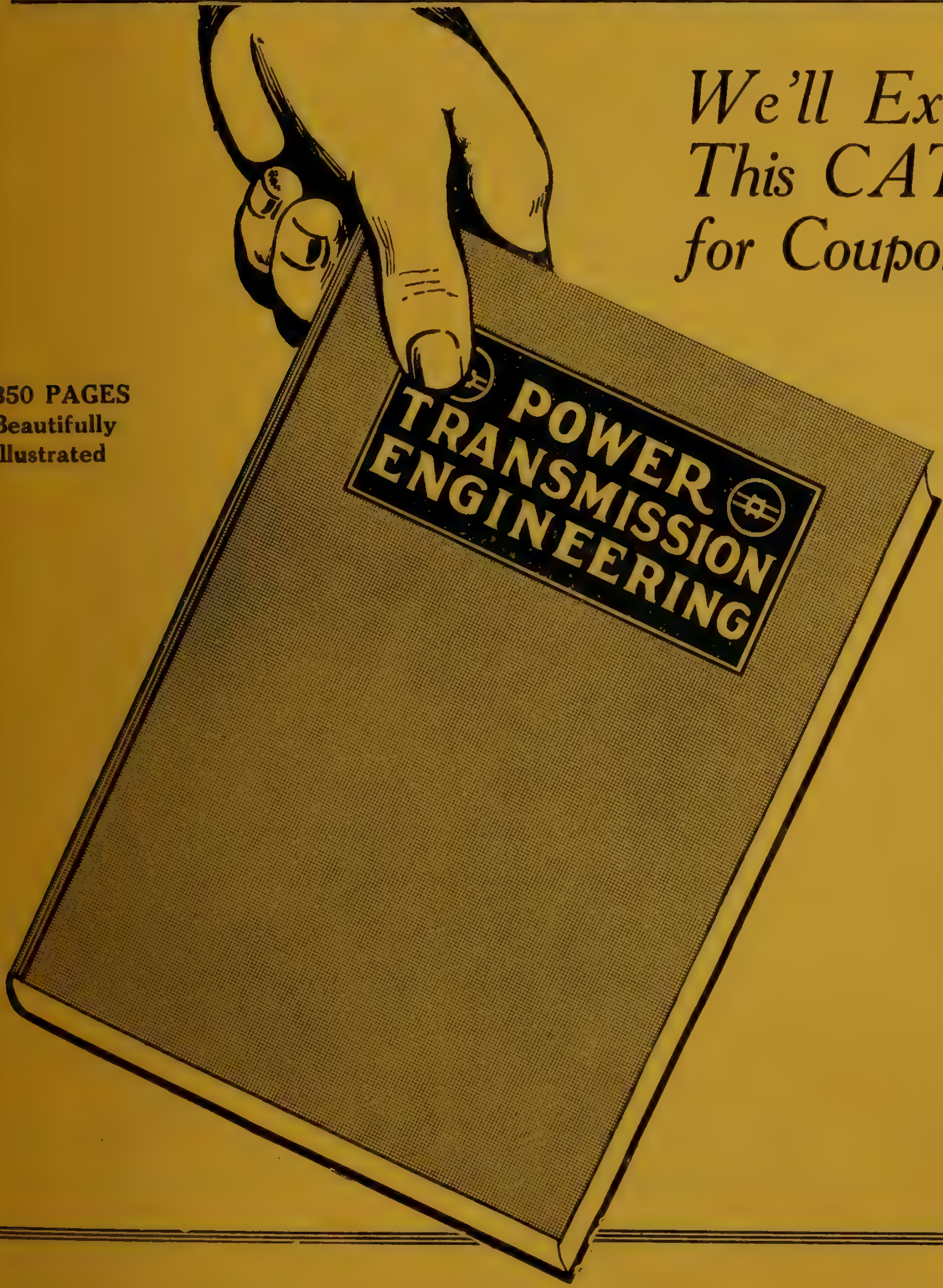
Toronto **Montreal**

Eastern Warehouse: 640 St. Paul St., Montreal, Que.

Agencies in all important centres of the Empire.

SHAFTING HANGERS PULLEYS
DODGE POWER TRANSMISSION MACHINERY
DODGE STANDARD WOOD SPLIT PULLEYS
DODGE MFG. CO.

We'll Exchange This CATALOG for Coupon



**350 PAGES
Beautifully
Illustrated**

This offer is only to engineers, power plant superintendents, shop superintendents, buyers. Stick or pin coupon to your firm's letterhead.

Dodge Mfg. Co., Ltd.
TORONTO, CANADA

Gentlemen:

Please send us your 350-page catalog, "Power Transmission Engineering."

Name ....

Address ....

....

Your Output Increased With Your Power Bill Reduced

Does This Interest You?

READ THIS REPORT
From a Superintendent and Engineer to their Managing Director

THE VICTORIAVILLE FURNITURE CO.
Manufacturers of Medium Furniture

Mr. J. E. Alain, Managing-Director, Victoriaville, P.Q., Nov. 20, 1913.
The Victoriaville Furniture Company.

Dear Sir:—

Since we have been operating with the Chapman Double Ball Bearings Shafting equipment, we have made a careful study of our cost and efficiency system, comparing the output with our old system versus the Ball Bearing; and have much pleasure in submitting the following report, which should be interesting to any factory using power. You will also note that the equipment of ball bearings installed on our line shafting so eased the load on our power plant through the elimination of friction that the machines were able to run at their proper speed with the following interesting results. These results are **entirely outside** of the saving in power which, in **addition** to the increased production, as shown below, will amount **to over 20 per cent. of the entire power:—**

Linderman Machine:—

The record of this machine on old system of transmission had an output of 2,600 ft. daily, when we are getting with Ball Bearing system an output of 2,800 ft. on the same machine, thus giving us a daily gain of 200 ft. based on direct wages of $5.65 per day, or 2,400 ft. for twelve working days, or a net gain of $5.22 for 12 working days or fortnight.

Planers, 3 machines and one Buzz Planer:—

Lumber ready to go through Sandpapering Machine:—

Old system took 404 hours to finish 49,000 ft., direct wages $31.20. Ball bearings took 390½ hours to finish 54,000 ft., direct wages $31.20. The above will show that we produced 1,210 ft. per day on old system, comparing with 1,380 ft. a day with Ball Bearings. 1,380 multiplied by 12 working days will give a total of 16,560 ft., being the production of twelve days with direct wages of $31.20, or a gain of 26 cents per thousand feet, based on 16,560 ft., will give us a net gain of $4.30 per fortnight.

H. B. Smith's Triple Sander Machine:—

Direct wages on old rate for an output of 21,715 ft. were $18.10, while the direct wages with Ball Bearings on an output of 35,400 ft. were $29.07, thus making a gain of 9 cents per thousand feet, based on 35,400 ft., being a fortnight's output, made clear gain of $3.18 for twelve working days.

(Signed) Frank McDonald, Superintendent.
" Jos. Beaudet, Engineer.

N.B.I.—The above has been referred to our Cost Accountant, and I have much pleasure to confirm the same.

(Signed) J. E. Alain, Managing-Director,
The Victoriaville Furniture Company.

Over 2,000 Canadian Factories are getting similar results. Can YOU afford to operate without Chapman Double Ball Bearings?

No trouble to change over—Our Bearings suit any standard Hanger.

Our Double Ball Bearing **LOOSE PULLEYS** will operate perfectly **WITHOUT LUBRICATION OR ATTENTION, EXCEPT A LITTLE VASELINE ONCE A YEAR.** Your loose pulley trouble will be a thing of the past.

Write us for particulars and let us figure with you on an equipment of Chapman Ball Bearings for your plant.

The Chapman Double Ball Bearing Co. of Canada

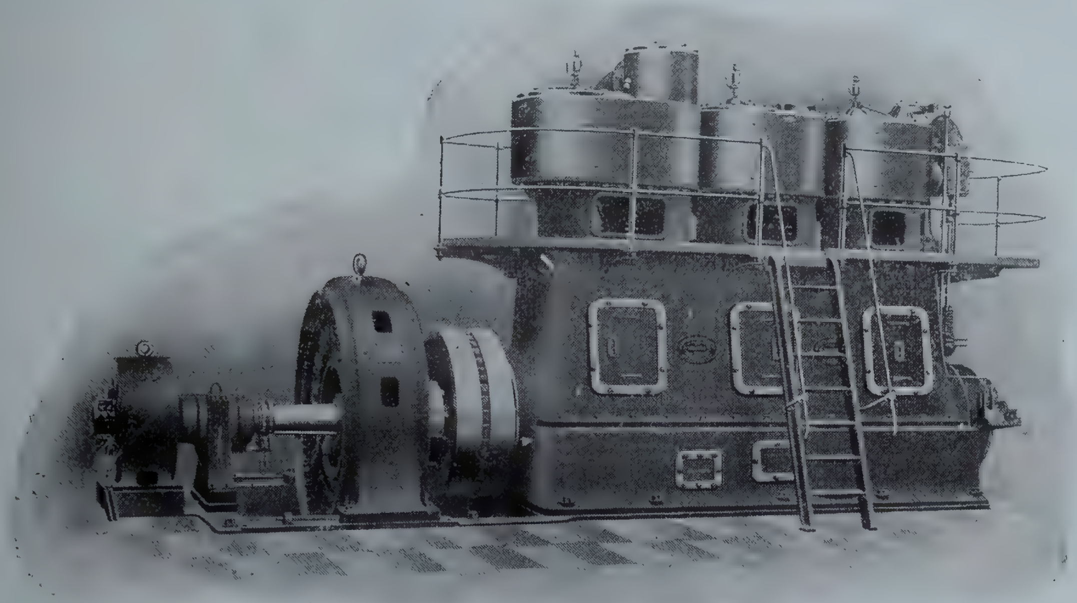
LIMITED
347 Sorauren Avenue, Toronto, Canada

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple **Efficient** **Economical**

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.

ECONOMY IN OPERATION

combined with A MAXIMUM OF SERVICE

can be had in your own engine room if you have the right equipment. If your present power equipment is not all that it might be, it would pay you to make it right and thereby save money. Remember that the first cost of installing Engines or Boilers is not so important a consideration as the cost of up-keep after you have them running. Get the best, not the cheapest.

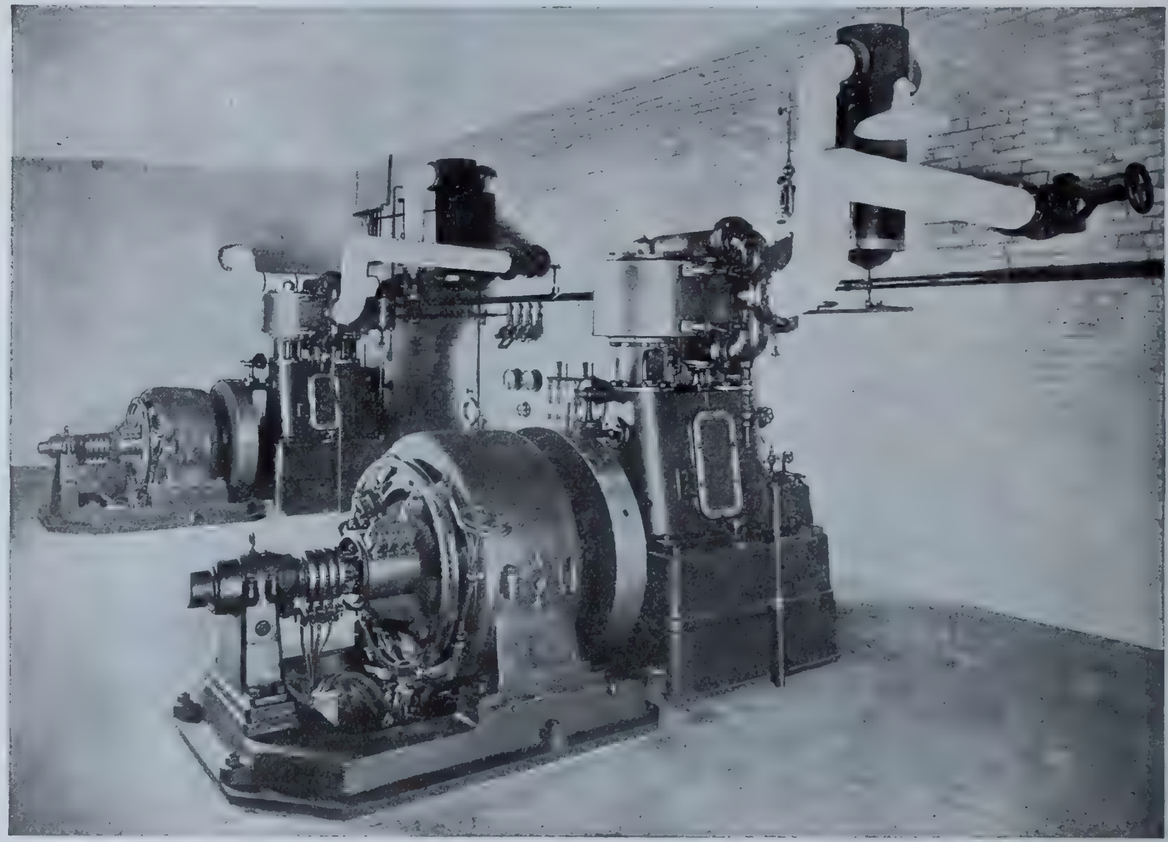


Illustration shows the Engine Room of the new Central Y.M.C.A. at Toronto, Ont., **Equipped with two of our Vertical, Forced Lubrication Steam Engines.**

Talk over this matter of economy in your power equipment **with our Engineering Department. Ask for our Catalogues.**

G. & McC. Co. ENGINES and BOILERS PROVIDE JUST that Economy and Service which is so Important.

THE GOLDIE & McCULLOCH CO., LIMITED

Head Office and Works: GALT, ONTARIO, CANADA

TORONTO OFFICE:
Suite 1101-2 Traders Bank Building.

QUEBEC AGENTS:
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248 McDermott Ave.,
WINNIPEG, MAN.

BRITISH COLUMBIA AGENTS:
Robt. Hamilton & Co.
VANCOUVER, B.C.

Power Plant Equipment, Harris Abattoir, West Toronto

Staff Article

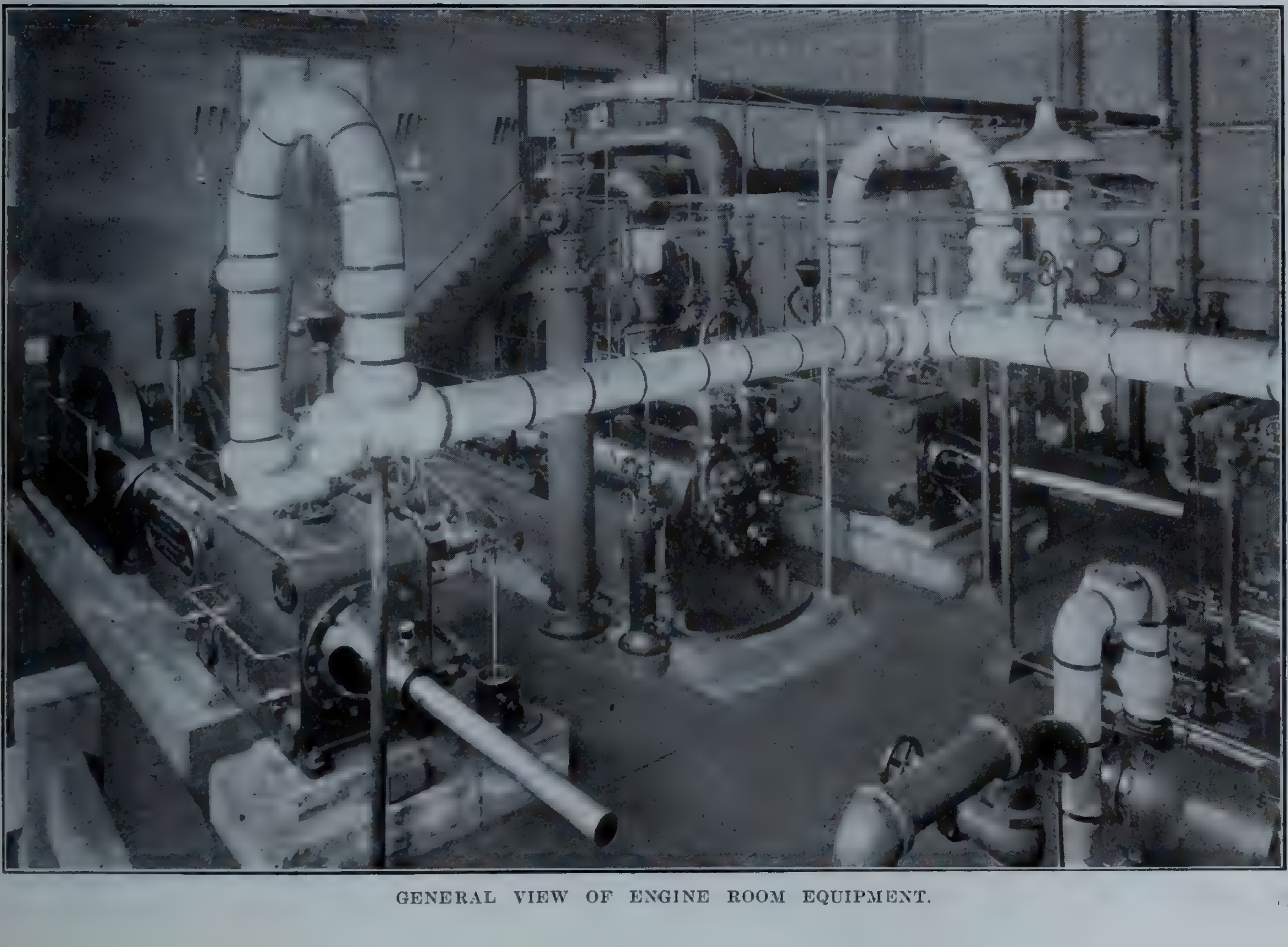
The Public Requirement of an Abattoir or Packing House is That Absolute Cleanliness of Method, Equipment, Interior and Exterior of Buildings, Habits and Actions of Employees, be the Prevailing Conditions Under Which Work is Carried on. The Management Requirement is that the Power Plant on Which the Industry Depends for its Source of Action, be Kept in Such Perfect Condition of Repair and Tidiness, that the Risk of Breakdown and Delay is reduced to a Minimum. A Shut-down in Summer in Plants of this Nature Means Invariably Considerable Loss, and in the Harris Installation, it will be Noted, Not a Little Foresight Has Been Displayed as a Preventive.

THE Harris Abattoir Co. recently started operations at their new plant, West Toronto. It is one of the best equipped for its particular purpose in Canada. The buildings, constructed of reinforced concrete with brick "curtain" walls and concrete floors, are arranged in two separate units, that on the west side being the abattoir and on the east side the cold storage building. Between the two blocks are tracks connecting with the railway in the north side of the property, while on the south side is a shipping platform extending the full length of the buildings. The power plant is situated in the west block where is also the can ice plant, while the cool rooms are in the east block with the offices adjoining.

Boiler Room.

The boiler room is a lofty brick and concrete building, 50 x 50 ft. In it are installed three Heine water tube boilers supplied by the Heine Safety Boiler Co., St. Louis, Mo., and erected by Mr. T. J. Main, Toronto. The boilers are each rated at 300 h.p. and are capable of being operated 50 per cent. overload. The working pressure is 150 pounds. They have "Dutch Oven" furnaces and Murphy mechanical stokers, each furnace being equipped with an Ellison differential draft gauge fitted above the fire-door. Each boiler is equipped with a soot blower furnished by the Baylie Soot Blower Co., St. Louis, and also with a patent high and low water alarm.

A very complete coal and ash handling plant has been installed. A spur from the railway tracks runs up to the boiler room, and the coal is dumped from the cars to bunkers below the tracks. The bunkers are below the boiler room floor level, which is again 10 feet below the ground line. The coal is carried from the bunkers by a vertical bucket conveyor to the top of the boiler room and discharged through spouts to two coal hoppers situated above the furnaces. The hoppers have a capacity of 40 tons of coal each, and have on the underside a swinging spout which enables the coal to be distributed with greater facility. At the bottom of each hopper is a door for controlling the amount of coal delivered to the scales where it is weighed before being put on the furnaces. The ash conveyor carries the ashes from the back of the boilers, under the boiler room floor and up to



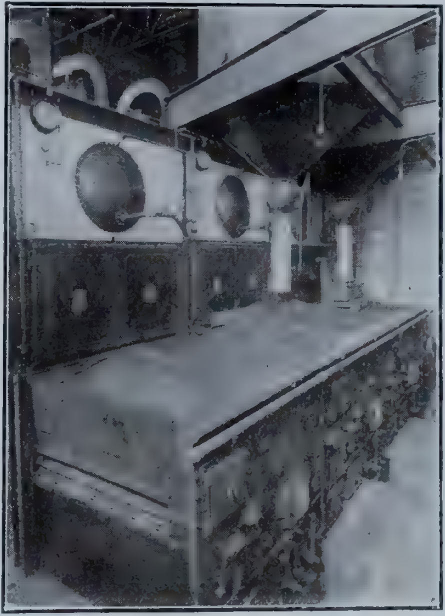
GENERAL VIEW OF ENGINE ROOM EQUIPMENT.

the tracks outside. The ashes are drawn from under the fires at the back of the boilers, in the basement, and put on the conveyor. In this conveyor system, the coal is only handled once, that is when it is being distributed over the furnace, and the ashes only once, when being put on the conveyor. This arrangement makes it possible to keep the boiler room clean and orderly as well as being a great saving of labor.

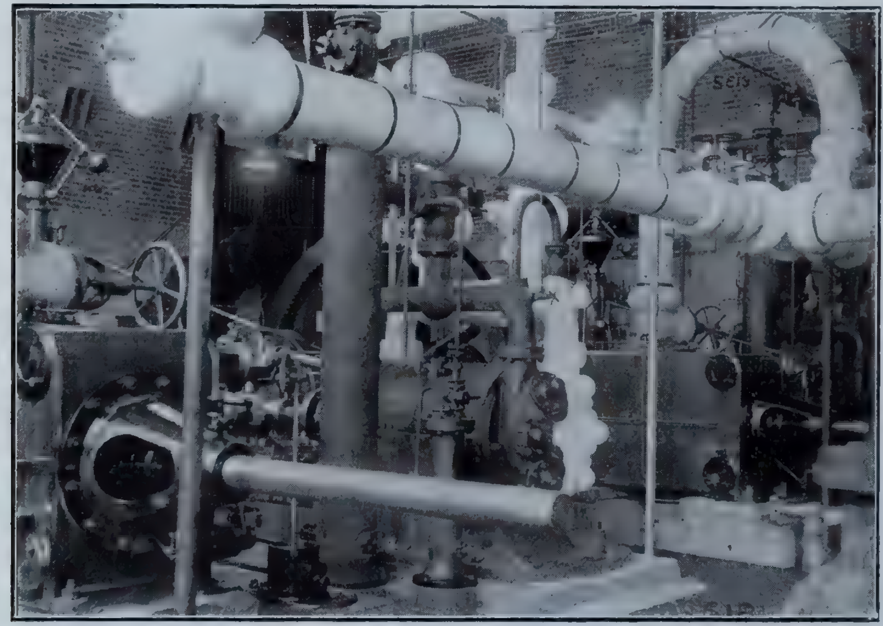
The main boiler header is 10 in. diameter, the branches 6 in., and the main steam pipe 8 in. diameter. All the steam pipes are covered with 85% magnesia compound supplied by the Canadian Johns-Manville Co., Toronto. The steel smoke stack is 6 ft., diameter and 150 ft. high. Tests are taken weekly with a "Hays" CO_2 recorder, the apparatus having been supplied by the Combustion Appliances Co., Chicago, Ill.

Pumping Installation.

The engine room is of the same size and construction as the boiler room and on the same level. Along one side are located the feed-water heater, boiler feed pumps and hot and cold water service pumps. The heater is of the "Cookson" type, having a capacity of 1,000 h.p., and was supplied by the Bates Machine Co., Joliet, Ill. There are two boiler feed pumps supplied by the Smart-Turner Machine Co., Hamilton. These are both 10-6-12 in., with pot valves and outside packed plungers, and deliver water to the boilers at about 200 degrees F. The hot water service is taken care of by a Mather & Platt type turbine pump having a capacity of 150 U.S. gallons per minute against a head of 185 ft. and direct connected to a C.G.E. 15 h.p. induction motor, 550 volts a.c. running at 1,450 r.p.m. For the cold water service, there are two pumps both of the same capacity and type, but driven by a steam turbine and motor respectively. The pumps are of the centrifugal type and have a capacity of 400 U.S. gallons per minute against a head of 125 ft., when running at 1820 r.p.m. A Terry steam turbine is direct connected to one pump and a 20 h.p. motor drives the other. The pumps and motor were supplied by the Canadian Allis-Chalmers Co., Toronto, and the turbine by the Hare Engineering Co., Toronto.



BOILER ROOM, SHOWING STOKER INSTALLATION.



LINDE-BRITISH COMPRESSORS AND "LEONARD" ENGINES.

In the basement under the engine room is an 18-16-12 in., Underwriters' steam fire pump having a capacity of 1,000 gallons per minute at 70 r.p.m. This pump was supplied by Canadian Allis-Chalmers Ltd., and is connected to a system of standpipes and also to the sprinkler system. Adjoining the above are two Smart-Turner Vacuum pumps 6½-7 in. for returning the drains from the heating system to the feed water heater. The hot water tank is situated near the pumps.

Switchboard.

The switchboard is located in the engine room and consists of four black slate panels, arranged in two sections, for power and lighting respectively. Each section has an instrument panel and a feeder panel. The current is taken from the Interurban Electric Co.'s mains and is stepped down from 22,000 volts to 550 for the motors, by three Crocker-Wheeler 300 k.w. transformers and to 110 volts for the lighting circuit by two Canadian Westinghouse 35 k.w. transformers. There are 40 motors installed throughout the plant, varying in power from 1 to 35 h.p.

Ammonia Compressors.

In the engine room are two ammonia compressors each having a capacity of 225 tons, the cylinders being 18½ in. diameter x 46 in. stroke. Both compressors were supplied by the Linde British Refrigeration Co., Ltd., Montreal, and are each direct connected to a Leonard Corliss engine, having a cylinder 22 in., diameter x 42 in., stroke and running at 60 r.p.m. The flywheel of each unit weighs 25,000 pounds and is 14 ft. diameter with a 12 in., face. The engines are equipped with safety stops and "Bowser" automatic journal lubrication, the oil being supplied by means of a small pump. The compressors have double suctions, the front end being connected to the ice tank, air cooler and piping in the abattoir building for Oleo cooling and storage. The back end of the compressors is connected to the sharp freezers on the third and fourth floors of the cold storage building, and the double pipe brine cooler in the basement of the same building.

The ammonia condensers are located on the roof over the ice tank room, and are of the "Wolfe" patent atmospheric type. They consist of 16 sections of 2 in. diameter pipe, 24 pipes high, fitted with a galvanized water trough over each coil and complete with all necessary gas and liquid headers and pump out connections. The liquid receiver which is placed below the condenser on the top of the engine room roof is 24 in., diameter by 16 ft., long with stands and valves. Water from the city mains circulates over the condensers and down to a tank on the boiler room level.

Ice Tank.

The ice plant has a capacity of 30 tons of opaque ice per day and is situated in a building alongside the engine room. The plant is operated on the flooded system and consists of a steel tank 56 ft. 9 in. x 21 ft. 9 in. x 48 in. deep and is made of 1/4 in., plate. The tank is divided into two sections, containing 416 cans of 300 pounds each; the cans measuring 11½ x 22½ x 44 in. deep inside. The tank is equipped with 8,000 ft., of 1¼ in. extra heavy coils placed in racks between the cans and connected to a liquid accumulator 24 in., diameter x 5 ft., long, from which the gas is drawn back to the compressor.

The brine in the tanks is circulated by means of two propellers 18 in., diameter running at 160 r.p.m., and driven by a 5 h.p. C.G.E. motor. Over the top of the tank there is an air-operated traveling crane operating over the full length of the room and having a capacity of 750 pounds, which is equivalent to lifting two cans at one time. The crane is equipped with a "Curtis" air hoist, the air being furnished by a Canadian Westinghouse, railroad type, compressor located in the engine room. The cans are carried to the thawing tank containing warm water which loosens the ice. The ice is then placed in the dump and delivered to a platform outside where it is carried by an elevator to a crusher and then delivered to the refrigerator cars. The tank is insulated in the bottom by cork board 6 in. thick and the sides are formed by the building having hollow walls with a 12 in. space filled with granulated cork.

Cold Storage Building.

The cold storage building on the east side of the property is constructed of reinforced concrete with brick "curtain" walls, concrete columns and floors. There are four floors, basement, and sub-basement, each having a cubic capacity of 95,000 feet. The fourth or top floor contains the sharp freezers. Part of the third floor is taken up by the offal freezer, the other part being a cool room, while the other floors and basements are cool rooms.

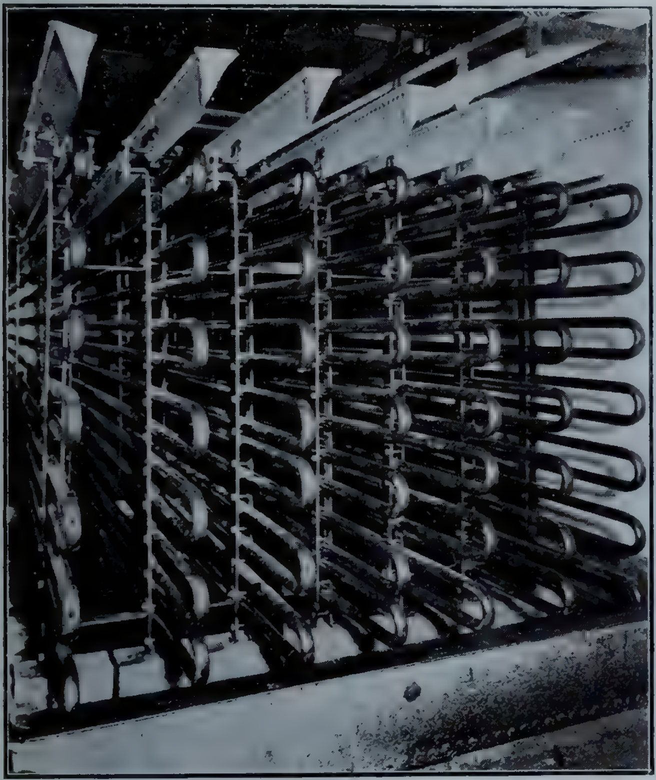
The top floor is divided into three sharp freezers, maintained at zero by a total of 18,000 feet of 2 in. direct expansion piping placed in grids suspended from the ceiling. The offal freezer on the third floor is cooled by piping placed in a similar manner and has also four pan freezer coils made up of grids of 2 in. piping placed in 16 in. centres and connected at one end by headers to the liquid and suction lines. The other section of the third floor is used as a hot beef cool room and is cooled by an air circulating system from coolers in the basement. The second and first floors are beef rooms while the basement and sub-basement are cutting and pickling rooms respectively. All the cool rooms are cooled by the air circulating system from air coolers located in the basement. The rooms are held at a temperature of from 30-32 degrees F.; each has a cubic capacity of 95,000 feet.

Air Coolers.

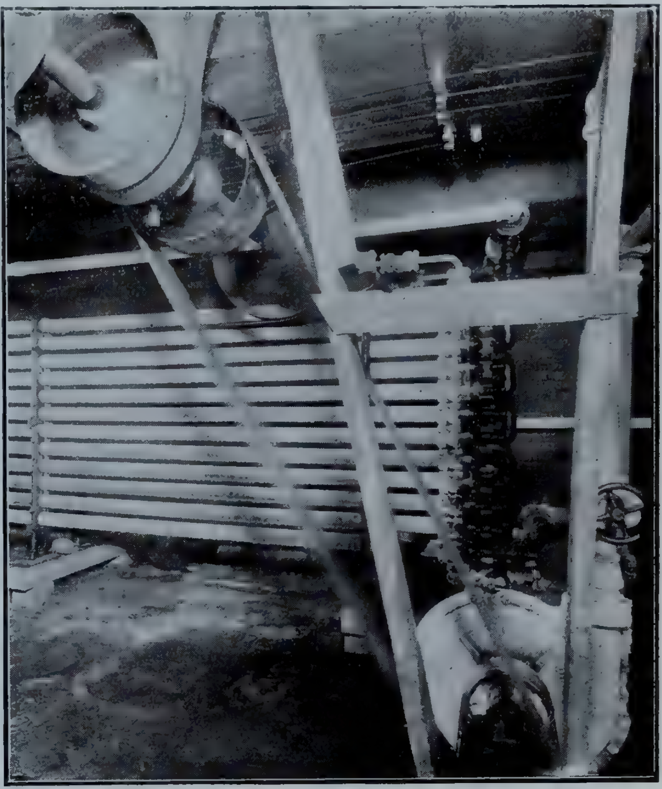
In the basement there are four air coolers arranged in separate units, each consisting of 3,000 feet of 1¼ in. extra heavy piping made up in grids and placed over a shallow tank for containing the brine, which is pumped from the brine cooler by a 2½ in. Smart-Turner centrifugal pump, located in the fan room adjoining. Galvanized iron troughs are laid over the full length of each coil for distributing the brine equally, thereby preventing frost from forming. The brine is cooled in a double pipe brine cooler, located in the fan room, and containing 725 feet of pipe. The inside or brine pipe is 2 in. diameter and the outside or ammonia pipe is 3 in. diameter.

There is a Sturtevant, multivalve type, fan installed with each cooler which draws air through the latter and delivers it through ducts to the cool room with which it is connected. The ducts are so arranged that the coolers can be operated together or as separate units. The fan and brine pump are driven by a 25 h.p. C.G.E. motor.

Outside the fan room is a closed brine tank and pump installed in connection with the lard roll on the first floor. The brine is cooled in the brine cooler already described. The centrifugal pump has a capacity of 100 U.S. gallons per minute against a head of 92 feet and is direct connected to a 5 h.p. motor running at 1,500 r.p.m. The pump and



A COOLER SHOWING AMMONIA COILS AND BRINE TANK.

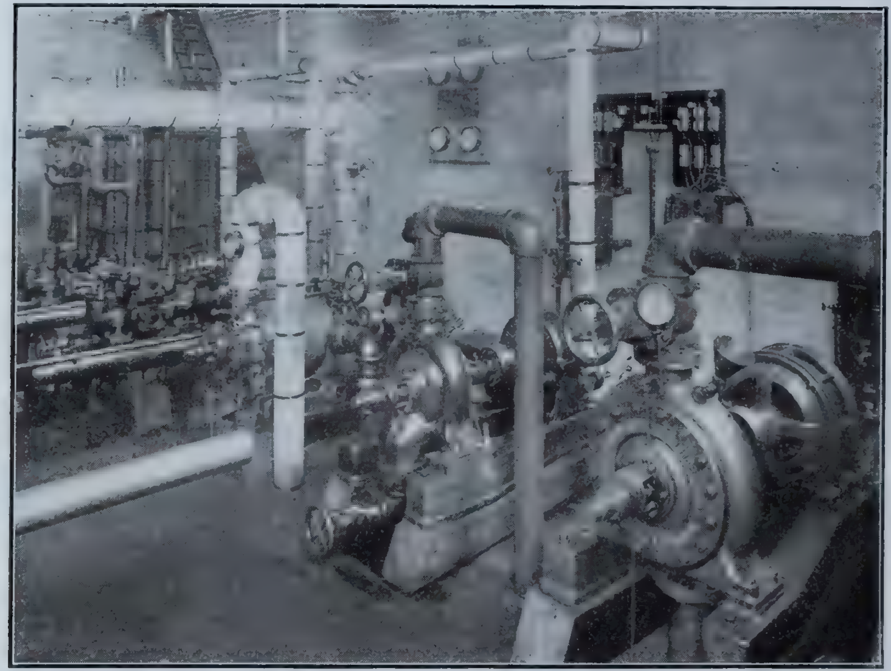


DOUBLE PIPE BRINE COOLER AND BRINE PUMP.

motor were both supplied by the Canadian Allis-Chalmers Co., Toronto.

The building is constructed with hollow walls having a 10 in. space filled with granulated cork, which forms the insulation for walls of the cool rooms and sharp freezers. The floor of the sharp freezers is laid with 4 in. cork board, and the roof is covered with 6 in., cork board over which is laid 4 ply standard roofing material. The floors and ceiling of the cool rooms are not insulated, but the walls of the coolers are insulated with 4 in. cork board. The insulation throughout the plant was supplied by the Kent Co., Montreal.

In the abattoir building there are three coils in the fat cooling vats and there are also coils in one room on the ground floor which is used as a storage for oleo.



BOILER FEED AND SERVICE PUMPS.

General Features.

In the abattoir building a machine shop has been equipped for making general repairs to the electrical and mechanical equipment. The machinery installed includes pipe threading machines, drill presses, lathes, etc.

The cold storage and the abattoir building are connected by a tunnel on the sub-basement level for providing a passage-way and also for carrying all the ammonia and steam piping and electrical wiring from the power house to the cold storage building and also to the office building.

The plant went into operation on November 1, 1913, and Mr. George Imrie, the chief engineer, advised our representative that the mechanical equipment throughout had given perfect satisfaction. The boiler installation had worked without a hitch and the pumps, engines and ammonia compressors had been thoroughly reliable.

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THREE-STRAND VERSUS FOUR-STRAND TRANSMISSION ROPE.

ALTHOUGH a large amount of four-strand transmission rope is used on the American continent, a three-strand rope is generally preferred in Great Britain and throughout Europe. It is in many respects the better of the two. Three-strand rope is laid more closely, and, there being no heart or core, the strands bear evenly on one another. With a four-strand rope, on the contrary, there is a space left in the centre which is usually filled up by a core.

The rule generally adopted in calculating the number of yarns which the core should contain is: Divide the number of yarns in all the strands composing the rope by 13. Take the case of a four-strand rope containing 132 threads—the core would be equivalent in bulk to 10 threads, while each of the strands would contain 33 threads. It will thus be seen that the core is much inferior in strength to any single strand, the result being that when the rope is strained the core is the first part to give way. Once the core is broken a space is left in the interior of the rope, one of the strands cuts in, the rope is stranded, and after a time goes to pieces.

Moreover, the strength of a four-strand rope is considerably less than that of a three-strand rope of the same diameter. A number of tests carried out by the United States Government at the Watertown Arsenal gave the following results:

Circ. Size.	3-strand.	4-strand.
2¼ inch.	6,206 lbs.	4,633 lbs.
3 inch.	9,800 lbs.	8,583 lbs.
4½ inch.	20,873 lbs.	18,100 lbs.

The above figures give the average of three tests on each size of rope, the ropes being pure Manilla. In addition to being stronger, three-strand rope can also be more easily and thoroughly spliced than four-strand, but the latter has the advantage of stretching less and also gives a larger surface in contact with the grooves in the pulleys.

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TORONTO HYDRO-ELECTRIC SYSTEM.

LAST year's business brought a net surplus of $34,576 into the coffers of the Toronto Hydro-Electric System, or approximately 3 per cent. on the total investment. The gross income amounted to $1,159,339.71 for the year, while the cost of current and the expenses of operation and management, including repairs and maintenance, absorbed $681,217.01, leaving a net balance of $478,122.70. The interest, depreciation, and sinking funds for the year amounted to $443,546.83. These figures show that the operating expenses were reduced 5½ per cent. from those of 1912, and the cost of current lower by 4 2-3 per cent., chiefly due to the reduced charge made by the Provincial Commission.

Notwithstanding the request of the Provincial Hydro Commission in regard to the reduction of rate, the report of the commission issued recently declares that a reduction of rates at this period in the development of the system would be unjustifiable. The statement points out that no complaint has been received from the customers relevant to the rates, but the commissioners state that whenever conditions warrant it, a reduction will be made, and say that it would be a breach of trust on the part of themselves to sanction any reduction before the financial condition of the enterprise justified it. "It is the policy of the commission to give in the first place a first-class service," reads the report, "and in the second place to give that service at the lowest cost possible. That policy will be strictly adhered to."

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Woman Wants Engineers' License.—Mrs. Victor Garnish, who was for twenty years a licensed engineer in Minnesota, on April 4, applied to take out a license in Regina to run her husband's traction engine, but the Saskatchewan law allows male engineers only. She says there are many women in the Province who would become engineers if they could.

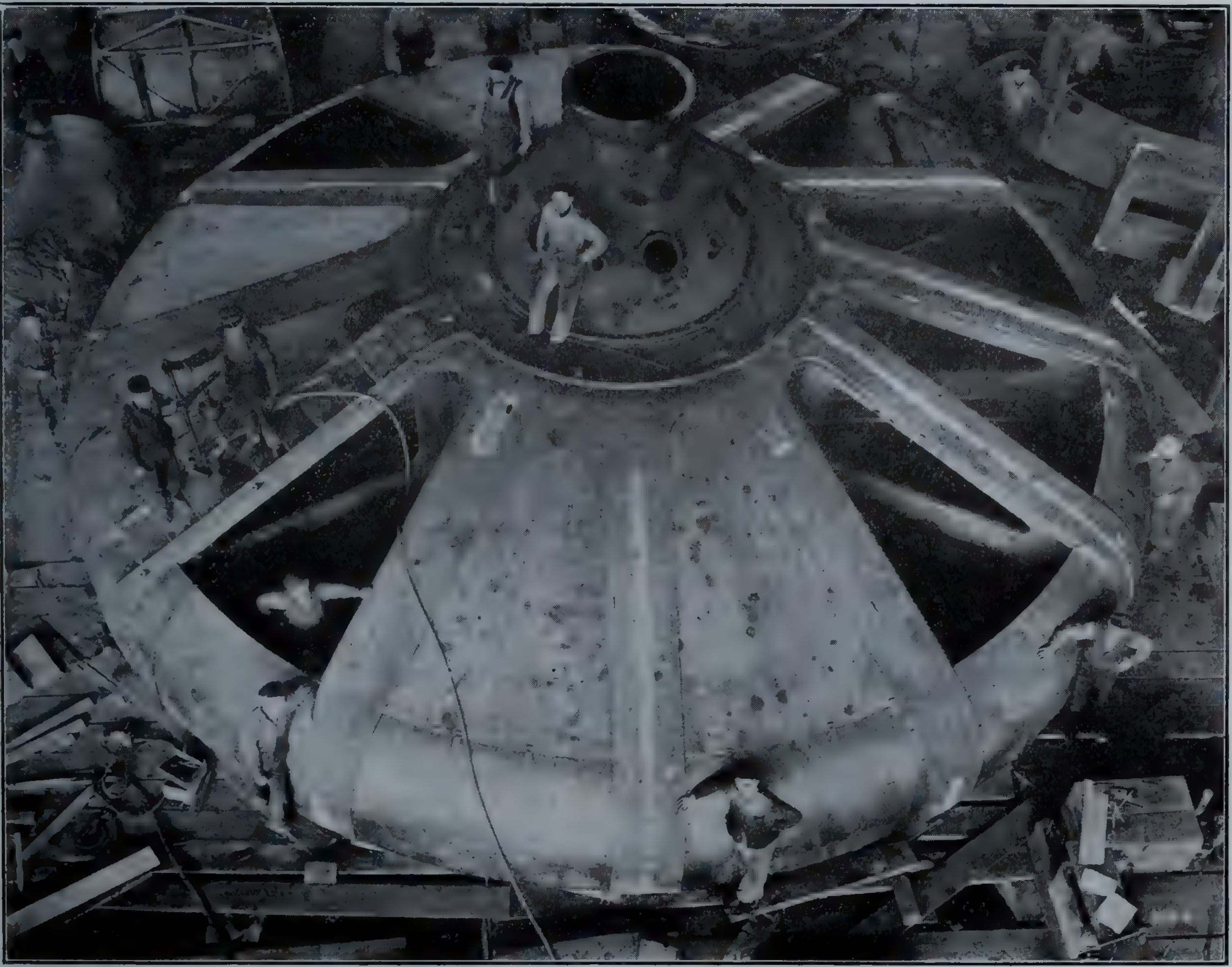
The Design and Construction of Hydraulic Turbines[*]

By H. B. Taylor, M. Am. Soc. M,.E.[**]

The development of the water powers of the world has turned the inventive genius of men in the direction of machine design distinct from that akin to steam operation, and the achievement realized in the latter sphere is being to a large extent duplicated in the production of engines whose motive power is derived from the harnessing of waterfalls in this and many other countries where the particular natural resources are available.

DURING the past ten years, hydraulic turbine design has passed through a stage of wonderful development and, in respect to many features, remarkable progress has been made toward bringing the turbine to a high state of perfection.

1. As a result of theoretical investigation, substantiated by experimental research of the highest order, efficiencies have been increased on the average about 10%.



MAIN UNIT THRUST BEARING SUPPORT, 10,800 H.P. VERTICAL SHAFT SINGLE RUNNER TURBINE FOR THE CEDAR RAPIDS MFG. & POWER CO., MONTREAL, UNDER CONSTRUCTION IN THE SHOPS OF THE I. P. MORRIS CO., PHILADELPHIA.

2. Corrosion of runner vanes, at one time a serious factor as affecting the maintenance of turbines and their efficiencies, has been eliminated subequent to conclusive demonstration that it is primarily the result of defective design.

3. The development of high specific speed runners, thereby permitting the use of higher rotational speeds, has resulted in the rapid passing away during the past few years of the multi-runner types of turbines in favor of the vertical shaft, single runner type.

4. At one time it was generally thought that the character of speed regulation of a turbine was dependent entirely upon the governor. To-day, however, it is known that the make or type of governor has little or nothing to do with speed regulation, except in so far as it must have sufficient power and proper mechanical adjustments to move the turbine gates in a certain time and without hunting.

Efficiency.

Ten years ago it was considered a notable achievement to obtain from a turbine in place an efficiency as high as 82%. The average of the best results secured was in the neighborhood of 80%. The maximum guarantees of the builders were from 78% to 80%, and were considered highly satisfactory. During the past two years, efficiences between 89% and 92% have been quite common, while a maximum value of 93.7% has been secured. To-day the builder must guarantee an efficiency of at least 87% in order to secure business.

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[*] From paper read before the Mechanical Section of the Canadian Society of Civil Engineers, Montreal, on Jan. 15, 1914.

[**] Hydraulic Engineer, the J. P. Morris Co., Philadelphia.

This remarkable increase in efficiency is by no means entirely due to superior runner design. As a matter of fact, the improvements in the design of wheel-casings, wicket gates, draft chests and draft tubes have increased the efficiency of the turbine as much as the more efficient runners.

It is interesting to note that the improvement in turbine efficiency has taken place during the time when the general policy of the power companies toward the builders has changed from one under which a great majority of contracts were awarded to the lowest bidder to the present one under which merit is frequently given first consideration. Under the former policy, business was secured by the builders at such prices as to allow little or no margin between actual cost and selling price. As a majority of turbine installations undertaken ten years ago were unsuccessful at the start, and required alterations or replacements to make them acceptable, the contracts which showed a profit were few and far between. Thus, there were frequently no funds available to cover the cost of experimental work by the builder to improve the quality of his product. As the data available ten years ago was by no means reliable, a majority of the buliders had very little assurance of the successful outcome of their work. There was, consequently, a very strong incentive on the part of some of the builders to avoid, if possible, the making of any tests which might prove that the apparatus had failed to meet the guarantees.

Merit of Product the Factor.

Most of the important contracts are now awarded on a basis of merit, and designs and guarantees are given far more consideration than price. A great amount of work is done on a cost and percentage basis, whereby the builder is guaranteed a profit, contingent, of course, on the proper execution of his part of the agreement. The ability of the builder properly to construct the apparatus in accordance with his designs is now taken into consideration in comparing competitive designs. A high guarantee of efficiency is no longer satisfactory to the purchaser unless it can be justified by conclusive evidence in the form of reliable data secured from tests on similar apparatus, or in connection with experimental turbines tested by disinterested parties. The builder who, by the presentation of such data, demonstrates that his guarantees will probably be exceeded, is given preference over his competitor who, although he may have made the same guarantees, is unable to prove that he has an equal margin in reserve.

Power Company Co-operation.

Engineers of power companies are now taking a much greater interest in the experimental work of the builders than previously, frequently volunteering to share in the expense; provided, of course, that such work will be of some aid to them in selecting the best type of apparatus. In some instances, power companies have allowed under contracts certain sums of money to be expended on experimental work to be carried out by the builder. In many contracts for waterwheels placed during the last few years the builders have been required to guarantee the efficiency on a bonus and penalty basis, the rate ranging anywhere from $1,000 to $5,000 per unit for each one per cent. of efficiency, the rate in each particular case depending, of course, upon the value of efficiency to the purchaser. This co-operation on the part of the power companies has been a very important factor in producing the remarkable improvement in efficiency which has been obtained during the past ten years, for it has made possible the expenditure by the builders of very considerable sums of money to cover the costs of research and experimentation. There is probably no doubt in the mind of anyone that the power companies have benefited many times more than the builders as a result of the experimentation made possible by their liberality. Another important factor in the rapid strides made in waterwheel design during the past ten years has been the co-operation on the part of consulting hydraulic engineers who, necessarily, have had a very extended and valuable experience in the design and operation of hydraulic machinery, and in the efforts of builders to solve various problems which present themselves, the advice of these engineers has been eagerly sought and cheerfully given.

Turbine Performance a Primary Consideration.

The present atitude of the power companies toward the builders has undoubtedly been the result of a better appreciation of the fact that the success or failure of any hydro-electric development depends primarily upon the performance of the turbines. The total investment of a hydro-electric development is represented in the water rights and franchises, the dam and power house, the turbines, generators, electrical transformers, the transmission lines and other equipment. This investment may involve many millions of dollars. The amount paid for the turbines themselves is only a small proportion of the total investment—say from 2½ to 10%. When it is considered that the success of the total development is absolutely dependent upon the proper performance of the turbines, and that the earning power of the total investment may be in proportion to the efficiency of the turbines, the folly of chancing the installation of inferior apparatus is self-evident.

In comparing designs prepared ten years ago with recent designs, the most striking feature is the absence in the latter of sudden turns and abrupt changes of section in all water passages from the turbine casing to the tail race; and, although in the older designs these passages were thought to be consistent with good results, they now appear to be exceedingly crude. The elimination of losses due to eddies and whirls, abrupt changes of section and sudden curvature in the various parts which constitute the turbine has improved the efficiency of the turbine as a whole. By means of the Pitot tube, it has been possible accurately to determine the conditions of flow in the various parts of the turbine casing, through the guide vanes, in the space between the guide vanes and the runner, and also in various sections of the draft tube. Thus it has been possible to compare actual conditions of flow in these various parts with the calculations.

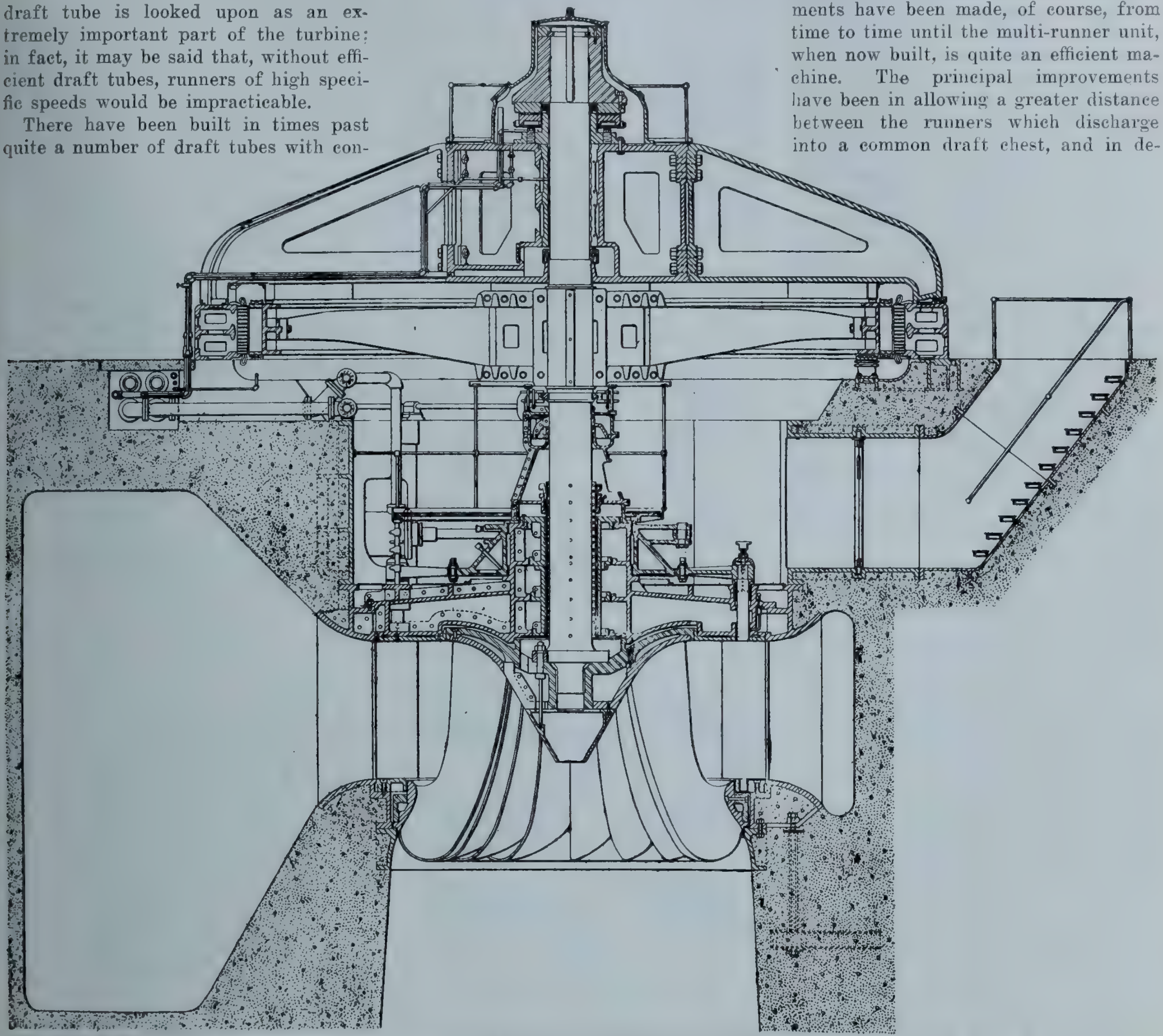
Waterwheel builders in the past five years have carried on very extensive tests at the Holyoke testing flume in Massachusetts on small runners ranging, in most cases, from 12 to 30 inches in diameter. These runners are exact models of the large runners which the builders contemplated installing in the turbines. Various designs of wicket gates and draft tubes are used in connection with the testing of these models. The results of these tests have given the builders very valuable data upon which to base the design of any new work calling for runners of like characteristics. The builders have also been able to secure from these tests empirical constants by which they have been enabled to modify their theoretical data.

Draft Tube Feature.

The head corresponding to the velocity of discharge from the runner into the draft chest or tube may represent a considerable proportion of the total head acting on the turbine. This is especially true in the case of runners of high specific speed, where this velocity head may be as great as from 25% to 30% of the total head acting on the turbine. It is, therefore, essential to design the draft tube most carefully, in order to convert this velocity into effective head.

Improvement in the design of draft tubes has been very marked indeed and has resulted in a considerable increase in the efficiency of turbines. It has only been within recent years that the hydraulic conditions within the draft tube have been fully appreciated. It was at one time thought that the draft tube was simply a device by means of which it was possible to locate the turbine above tailwater level without losing the effective head represented by the difference in elevation between the turbine and the tail race. To-day, however, the draft tube is looked upon as an extremely important part of the turbine: in fact, it may be said that, without efficient draft tubes, runners of high specific speeds would be impracticable.

There have been built in times past quite a number of draft tubes with constant diameter from the rummer to the tail race. Consequently, the velocity which existed in the section immediately at the discharge from the runner existed also at the end of the draft tube, and the energy represented by this velocity was entirely lost to the turbine, in addition to the frictional loss resulting from the condition of high velocity throughout the entire length of the draft tube. The efficiency of turbines with draft tubes so designed is necessarly extremely low. By properly designing the draft tube from the section immediately at the discharge from the runner to the tail race so that the velocity is gradually reduced from a maximum at the runner to a minimum at the tail race, the vacuum in the draft tube may be increased and, consequently, the effective head on the turbine.



CROSS SECTION OF A 10,800 H.P. VERTICAL SHAFT SINGLE RUNNER TURBINE UNIT FOR THE CEDAR RAPIDS MFG. AND POWER CO., MONTREAL.

The Runner Feature.

Until the last two years, a large majority of the turbines installed in connection with low and medium heads were of the old fashioned multi-runner type, consisting of two, four, six and sometimes more runners on a shaft, these runners being grouped in pairs, each pair discharging into a common draft chest and tube. The energy represented by the velocity at the discharge from the runners was practically lost to these turbines, owing to the losses due to impact and eddies and whirls existing in the draft chests and tubes, as a result of the runners discharging against each other. Consequently, there was practically no reconversion of the velocity head from the runners into useful head.

Ten years ago, the draft chest and draft tube designs of turbines of these types were exceedingly crude. Improvements have been made, of course, from time to time until the multi-runner unit, when now built, is quite an efficient machine. The principal improvements have been in allowing a greater distance between the runners which discharge into a common draft chest, and in designing the draft chest so that the water from each runner is carried into the draft tube to a point where the two streams are moving in parallel directions, before allowing them to converge; but even with the best design of turbines of the multi-runner type, there is always present an appreciable loss due to the comparatively sudden turns which the discharge water from the runners must necessarily follow.

With runners of medium specific

speed in a multi-runner setting, it is sometimes possible to obtain efficiencies approaching those developed by the experimental runner; provided, of course, that the draft chests and draft tubes have been carefully designed. In other words, the losses in the draft chest and draft tube about equal the losses which exist at the Holyoke testing flume, where the runner is small, and where the intake and draft tube losses are necessarily appreciable on account of the construction of the flume. On the other hand, should runners of extremely high specific speed be adopted, in which the discharge velocity from the runners represents a very considerable portion of the total head acting on the turbine, it is found that the efficiency seldom reaches that of the experimental model. It may be mentioned that the experimental model is usually operated in a vertical setting, with a single draft tube, and consequently the losses which exist in the draft chest of the multi-runner setting are not present in the experimental setting.

Reliability and Stability of Construction

In many of the power developments carried out a number of years ago, and in some few instances in more modern plants, even such efficiency as could be obtained from the turbines cannot be realized in the operation of the plant as a whole. Poor designs of the waterways leading to the turbine casing and receiving the discharge from the draft tube cause considerable losses outside of the turbine passages. In some instances, much attention has been given to slight variations in turbine efficiency, while losses of head amounting sometimes to one or two feet, occurring through submerged arches, bridge piers or racks, have been overlooked.

Many recent developments are being much more carefully worked out, so that there are gradual transitions in water velocity at entrance to the turbine casing and at discharge from the draft tube into the tailrace; and practically the entire efficiency of the turbine is realized in the operation of the complete plant.

Accompanying a growing appreciation of the value of efficiency, engineers are giving increased attention to the mechanical features of turbine designs and to questions of deterioration of the machinery during operation. It is now realized, especially by those who have been taught by the school of bitter experience, that mechanical reliability and stability of construction are of even more importance than efficiency, since continuity of operation and freedom from interruption for repairs are vital considerations. Among other sources of interruption to service, the deterioration of runner vanes has in the past been a frequent cause of trouble.

Corrosion of Runner Vanes.

Corrosion, or pitting, of runner vanes, guide vanes and draft tubes, is no longer a serious obstacle to be contended with in the operation of hydraulic turbines as its cause is now pretty well understood and, by correct designing, can be eliminated. Turbine builders do not hesitate to design and construct turbines for operation under any head up to 650 feet and to guarantee their lasting qualities, provided the speed and power in each case are so chosen as to be consistent with favorable hydraulic conditions. Corrosion, or pitting, must be distinguished from erosion, which is mechanical wear due to the presence of foreign substances in the water. Erosion is entirely a mechanical action, while corrosion, or pitting, is the result of chemical action. The abrasive action of foreign substances in the water has the effect of first polishing the vane surfaces, and eventually cutting away the metal until the vanes are worn entirely through. The eroded parts are, therefore, smooth and can be readily distinguished from the pitted marks which result from corrosion.

The elimination of corrosion as a serious factor in turbine design is the result of a careful study of the subject, after many years of costly experience on the part of both the power companies and the turbine builders. It has been demonstrated that corrosion is primarily a question of design. It has been clearly shown in practice that where sharp curves are resorted to, where contraction is not sufficient, or where there are pockets formed in the surface of the vanes, pitting or corrosion inevitably develops. It has also been demonstrated that where air in large quantities is entrained in the water carried to the turbine, corrosion seems to take place very rapidly if the design is not correct.

While it is true that corrosion takes place more quickly under high heads than under low heads, runners operating under heads as low as 25 to 30 feet have been found in some cases to corrode very rapidly. It is, therefore, essential that the runner be carefully designed, regardless of the head under which it is to operate, but extreme precaution must be taken in cases where the head is excessively high. A corroded vane surface has an appearance resembling a sponge, the surface being extremely irregular and the pitted spots often opening holes entirely through the vane. Chemical analysis of the corroded surfaces has brought out the fact that the metal has been oxidized. In runners made of bronze or an alloy, modifications in the composition have been detected in the corroded portions.

Theory of Corrosion.

The theory of corrosion as now generally accepted is that the water in passing over any pocket or depressed surface, or in failing to adhere to the surface of the vane, leaves spaces which are filled with eddies possessing high velocities and very low static pressure, in which oxygen is liberated from the water. This oxygen is believed to be in the nascent state and rapidly attacks the surface of the metal, forming an oxide coating, the greater part of which is rapidly washed away by the water. When once the depth of this pocket is increased by corrosion, it is natural that, due to the greater area exposed, the pitting action should continue at an accelerated rate until the vane is entirely eaten through.

It is quite likely that electrolysis is present as a result of the oxidation of the metal, for it has been noticed in connection with runners of the built-up type—viz., runners in which plate steel vanes have been used with iron or bronze bands and hubs—that corrosion seems to develop more rapidly than in the case of runners made of uniform metal. Foreign engineers have called attention to the fact that in some instances they have observed that the metal eaten out by corrosion at one section of the runner has apparently been re-deposited at another section, a condition evidently resulting from electrolysis. If electrolysis does exist, it is a secondary action and may be eliminated by first preventing corrosion.

The fact that a runner develops high efficiency under test is not, necessarily, a guarantee that corrosion will not take place. Small defects in the curved surfaces of the runner vanes will be very quickly brought out by the fact that they corrode; while on the other hand these defects in the flow through the runner, may be too small to be detected in an efficiency test. In general, however, it may be said that high efficiency and freedom from corrosion are complementary qualities.

* * *

Vancouver, B.C.—A new cold storage plant is to be erected by the Vancouver-Prince Rupert Meat Co. on Water Street, at a cost of about $80,000. A building permit was taken out in January for the basement portion, costing $6,000, and since then plans have been in preparation by the company's architect. The building will be 33 feet by 120 feet and six storeys in height. It will be of brick and mill construction and complete as regards facilities for handling meat for Vancouver consumers.

Breakdowns of Stationary Engines, Their Cause and Cure-II.

By Michael Longridge

The accompanying article, which formed the subject of a recent lecture before the Graduates' Association of the Institution of Mechanical Engineers, is one of special interest to power plant operatives. While this is so, the fact that faulty design and careless installation have played a large part in many "smash-ups," makes the advice relative thereto of considerable value to those whose work lies in these particular spheres. The author of the paper is the well-known Chief Engineer of a large and leading English power plant equipment insurance company.

IN our March issue the contributory part that flywheels, valves and valve gears, pumps, bed-plates and cylinders, played in the matter of stationary engine breakdowns was discussed. In the present and succeeding article on the subject the relative place which spur gears occupy is dealt with.

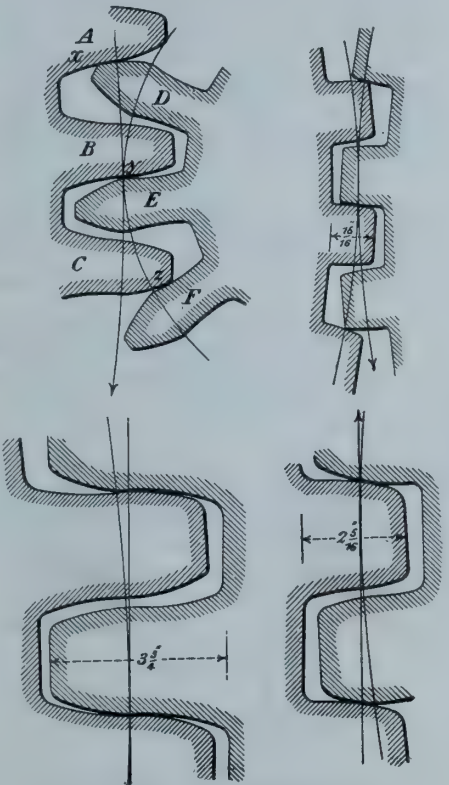
Spur Gearing.

About 1879, when horizontal engines of 800 to 1,200 indicated horse-power began to replace beam-engines of half that power in cotton mills, when pitch-line speeds were rising from 1,800 ft. to 2,300 ft. per minute, loads on teeth from 10,000 lbs. to 18,000 lbs., and gear ratios from 2¼ to 1, 3 or 3½ to 1, an epidemic of breakages of spur-gears set in. Some 20 per cent. of the engine breakdowns were breakages of spur-wheels on engine crank-shafts, and the pinions driven by these wheels broke almost as frequently. Many of these breakdowns were due to irregularities of pitch, twisted teeth, sinuosities of pitch circles, concentration of pressure on the end of teeth through movement of crank-shaft, back-lash from the momentum of rope-drums on second-motion shafts, and other faults of workmanship and use, common to old-pattern moulded wheels and to old engines.

The damage, however, was not confined to these. Many new wheels, as good as mechanical skill could make them, with teeth moulded by machinery, spur-runs, cast in complete circles, and machined internally, carried on crank-shafts held in pedestals, with brasses adjustable horizontally as well as vertically, broke also. These breakages were usually attributed to "vibration," "wear and tear," "teeth bearing up to points," and similar effects of a cause ignored or not discerned. That cause, in my opinion, was the use of teeth too long and too wide to "correspond with their environment," the most important fact of that "environment" being the unavoidable motion of the engine crank-shafts on which the driving-wheels were hung.

Spur Gear Breakage Explanation.

I will try with the aid of Figs. 32 to 35 to make this clear. Fig. 32 represents three teeth (A), (B), (C), of a spur-wheel geared with three teeth, (D), (E), (F) of a pinion. The teeth are supposed to be cycloidal, for involute teeth have not found favor with makers of main driving-gear. Their length is exaggerated to make this illustration clear. Similar profiles can be set out, according to the rules in the books to provide three points of contact (x), (y), (z), and three teeth to carry the load. They look very pretty upon paper, but they will not work if the spur-wheel (A), (B), (C) be forced towards the pinion (D), (E), (F), by the motion of the shaft.



FIGS. 32, 35. SPUR GEAR TEETH BREAKAGE FEATURES.

The contact at (y) ceases. The pressure is taken off (B) and is concentrated upon the points of the teeth (C) and (D), and there intensified enormously by the forcible retardation of the driving-wheel or acceleration of the pinion. Again, even if the crank-shaft could be held absolutely steady, the same effect might be produced if the teeth came from the mould full at the points, or if the pitch-line had proud places, both common defects in uncut wheels. If, however, the faces of the teeth were cut away sufficiently to limit the contact to the immediate neighborhood of the pitch-point (y), the motion of the wheel towards the pinion would simply cause the tooth (B) to slide on (E) without strain or change of angular velocity.

Of all intermediate positions of the point of contact it may be said that the further it moves from the pitch-point, the more destructive become the effects of shaft displacements, incorrect tooth forms, or sinuosities of pitch lines, and conversely the shorter the path of contact the less the mischief resulting from these unavoidable irregularities. Experience has led millwrights to the same conclusion, for they invariably set out wheel teeth so fine at the points and roots that they bear only near the pitch line when new, and when through wear the bright bearing surfaces extend to the points of the teeth, they chip the points to avert the damage just referred to.

The question is, why do they leave surfaces which are not used when the teeth are new and which have to be chipped off when the teeth are old To this I never could get a satisfactory answer. Neither as far as I know, would wheel makers cut short their teeth till 1888, when a firm of engineers consented to make a pair of wheels with short teeth, Fig. 33, for their own shop engine.

These wheels must have felt like the first lady who appeared in public minus a crinoline, so greatly did they differ from the fashion of their day. They had 49 and 47 teeth, of 2 5-8 in. pitch, 15-16 in. long and 4 1-2 in. wide, the ratio length to pitch being 0.36. With fixed centres and accurate moulding, teeth 1-4 in. long would have kept contact. These wheels held their grease well and ran smoothly, till the engine was replaced in 1892. They were but small, and running at a low speed (1080 ft. per minute), but they were more convincing than arguments or drawings, because they were made of cast iron and could be seen at work.

Figs 34 and 35 show what they accomplished in a few months. The former shows the teeth of a wheel and pinion installed in November, 1888, after two other sets of gearing had been destroyed in the space of eleven years. The teeth were 4 13-16 in. pitch, 3¾ in. long, and 19 in. wide, while the distance between the centres of the shaft-bearings was only 66½ in. With these dimensions and a pitch-line speed of 2410 ft. per minute, the motion of the crank-shaft threw the whole load of 16,400 lbs. upon the corners of the teeth and drove the points of the pinion-teeth into the flanks of the wheel-teeth with jar and vibration sufficient to break one of the segments in the following March. Then more teeth were cracked and more segments broken, and it became necessary to replace the entire rim. The new rim was made of steel, with teeth of the same pitch and breadth as the old, but 2 5-16 in. instead of 2¾ in. long, Fig. 35. They would have been better 1½ in. long.

The tooth of an engine-driving-wheel is a cantilever whose strength varies not as pitch 2 × width ÷ length, but as pitch ÷ length, because, with a short and moving crank-shaft, very little, if any strength is gained by making the width of a tooth more than one pitch. Thus a reduction of length to 1½ in. would have permitted a reduction of pitch to 3¼ in., an increase in the number of teeth in both wheels, a shortening of the necessary path of contact, and, if three pitches be considered a sufficient width for the teeth of one engine driving-wheel, as I think it is, less concentration of pressure on the corners from the lifting of the shaft.

Double Helical vs. Straight Teeth.

Some people consider double-helical teeth stronger than straight teeth. This is a delusion. Width for width of wheel-face, they are much weaker, because, owing to the lifting and end-long motion of crank-shafts, the pressure never acts on both treads at the same time, unless provision be made for allowing the pinion-shaft to move end-ways, and, even, then, the force required to overcome the inertia of the pinion and its shaft adds seriously to the pressure on the teeth. There is another cause of destructive vibration—namely, irregularity of pitch and inequality of pitch of wheel and pinion. The first is seldom important in machine-moulded wheels, and can generally be rendered innocuous by chipping and filing. The second, depending upon the contraction of the castings, can only be remedied by gearing the wheels more or less deeper than was intended by the designer.

In my opinion, both wheels of a pair should have pitch circles turned on both sides of the rims, with radii proportional to the number of teeth in each, whether they be the radii marked on the drawing or not. The wheels should be geared to these circles and kept there. The change of the position of the pitch-point on the profile will not materially affect the velocity ratio if the teeth be short. The fashionable length of teeth is now 0.45 to 0.55 of the pitch, instead of 0.66 to 0.75 as formerly, and it might be reduced still more with advantage in many cases.

I should like to have said something about the breakages of spur-wheels other than breakages of teeth, but as most of the breakdowns of these wheels originate in the teeth, it seemed best to devote the time available exclusively to them. The breakages of spur-gearings are now 10 per cent. of the total breakdowns. The reduction in the percentage from 20 to 10 is principally due to the supersession of gearing by ropes. The improvements in design and workmanship have done little more than enable wheels to live under conditions which the old wheels could not have faced, but they have done something, and the substitution of steel for iron, of cut or milled for moulded teeth, and of shorter teeth and correspondingly finer pitches, will do a little more, but I doubt if it will ever be possible to transmit more than, say, 1200 horse-power from the crank-shaft of a steam-engine by spur-gearing.

FACTORY ACT AMENDMENTS.

INSPECTION of all boilers in use in Ontario, excepting those in private residences, is to be made compulsory in an amendment to the Factory Act introduced into the Legislature by Hon. James S. Duff last week. The present law provides for the inspection of all boilers used in factories, shops and office buildings at least once a year, but there appears to have been no inspection of boilers in hotels, schools, theatres and other public buildings.

The proposition for general inspection was first linked with the suggestion that the boilers be inspected by the province, but as half the boilers in the province are under private inspection, the boiler insurance companies would practically be forced out of business.

The Stationary Engineers Act is to be amended, bringing all men in charge of hoisting engines under the law, so that in future they will have to secure certificates as other stationary engineers have to do.

The Rope Drive as a Power Transmission Medium

By E. H. Ahara, Mishawaka, Ind.

Being an abstract from a paper read before the American Society of Mechanical Engineers, covering a series of tests on the transmission of power by rope-drive under various conditions.

CONCLUSIONS deducible from the data obtained seem to show that the efficiency in rope driving is considerably greater at the lower speeds than at the higher ones, the dropping off being especially noticeable above 4,500 ft. per min. of rope speed. They also show that the efficiency of a rope drive is not materially affected by distances between centres up to 150 ft., that the drop of

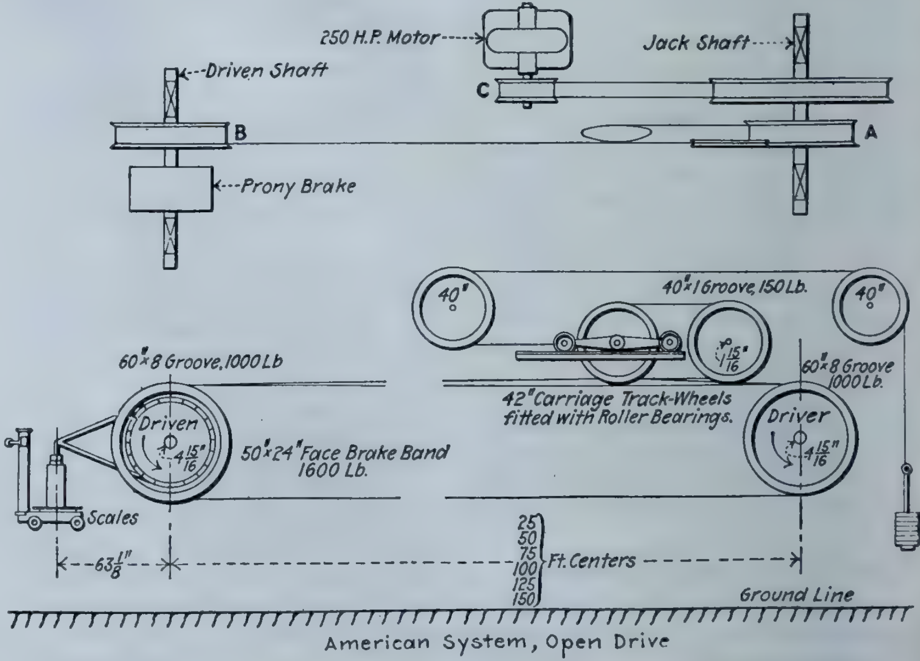


FIG. 1. GENERAL PLAN OF AMERICAN OPEN OR STRAIGHT DRIVE SYSTEM.

efficiency at 50 per cent. load is comparatively small over that of full load, and that if proper care be exercised to have all grooves perfect in pitch diameter, many as well as few ropes can be run on a drive with good efficiency. With the American system, increasing the slack rope tension up to 360 lb. in a 1-in. rope does not appear to decrease its efficiency, but rather to increase it, if power be used in conformity with this tension; but only such tension should be used as is necessary to drive the load needed.

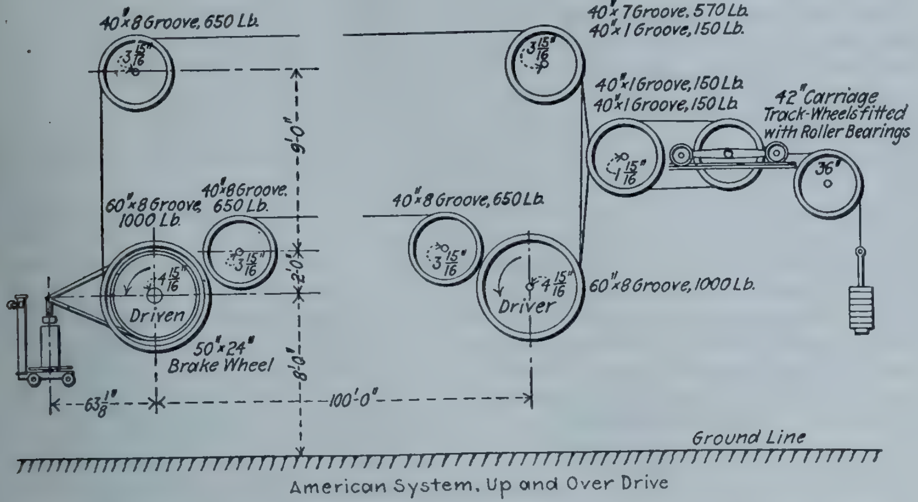


FIG. 2. GENERAL PLAN OF AMERICAN UP AND OVER, OR INDIRECT DRIVE SYSTEM.

The efficiency was measured under full, three-quarters, one-half and one-quarter loads, while one-inch best Manila rope was used. The tests cover drives of from one to eight ropes, with centres from 25 to 150 ft., on both American and English systems; also open or straight drives, as well as indirect, or up and over drives. For the rope tested the American system has very much more capacity than the English system, and has also a higher percentage of efficiency. In general it would appear that, where there is a considerable power to be transmitted, the properly worked out rope drive gives a most efficient and economical method, and where conditions are favorable to its installation no other known method of transmission will so well conserve power losses.

The efficiency as determined includes the losses in the rope itself, the friction in the bearings on the driven shaft, and the losses due to the inertia of the driven wheel and the prony-brake wheel, and, also, in the American system, the friction of the tension equipment. All tests were made to include the friction of the receiving shaft and bearings as if it was thought this would more nearly approximate working conditions and make the data obtained of more general application in ordinary comparisons. All bearings used were of the ring oiling babbitted type, and the ropes were all 1-in. Manila rope of best quality, carefully treated with a rope dressing to prevent the entrance of moisture and to keep the surface in as nearly uniform condition as possible. It was found during the test that this was of great importance as very slight changes in the rope surface immediately affected its capacity and efficiency.

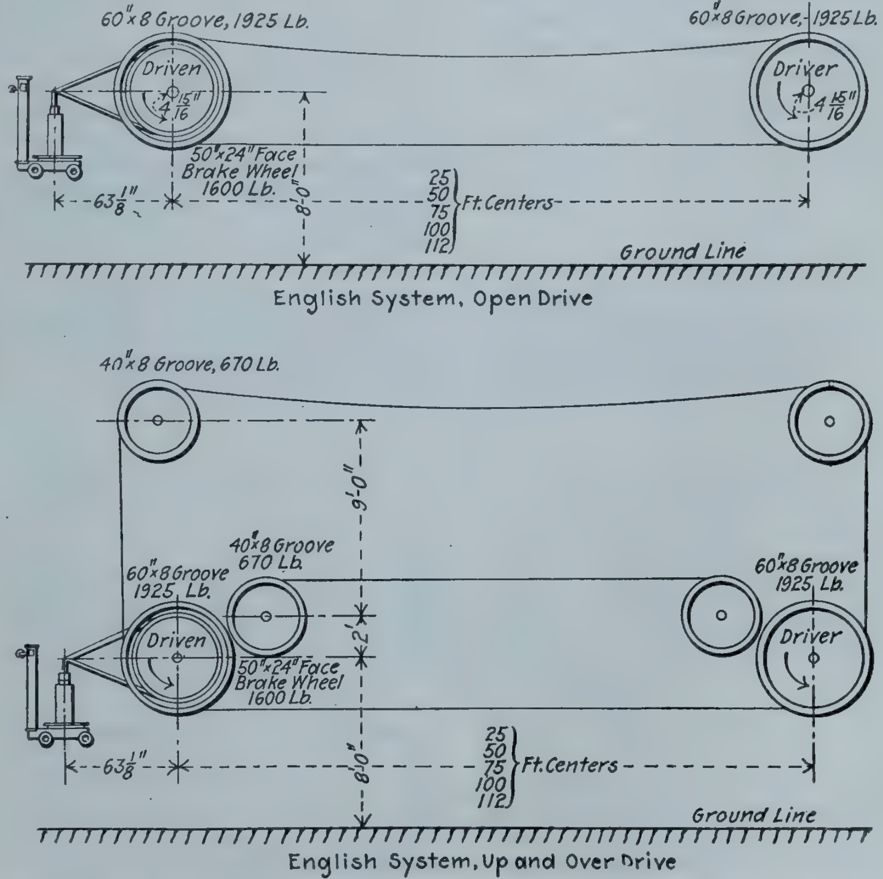


FIG. 3. PLAN OF ENGLISH OPEN DRIVE AND "UP AND OVER" DRIVE SYSTEMS.

With the American system, a lower efficiency is shown on the lower number of ropes. This is undoubtedly caused by the fact that the eight-grooved wheel made for testing eight ropes was used for all the lesser number of ropes to avoid the expense of making additional wheels with a suitable number of grooves for each drive. This together with the weight of the prony brake increased the proportional friction on the smaller loads, and is, therefore, a larger percentage of the total load in the drive of few ropes. With the friction of driven shaft eliminated, limiting the losses to those in the rope alone, it is believed the efficiency in a single rope would be as great, if not greater, than any multiple thereof.

In all of the above tests the tension in the slack side of the rope was kept as uniform as possible at 180 lb. by means of weighing the tension carriage properly. In order to ascertain what tension would give the greatest degree of efficiency, irrespective of life of rope or wearing qualities, a test was made with the slack rope under varying tensions. This was determined on one rope because the capacity of the single rope was, under the heavy tension, as great as that of the motor, so no proper comparison could be obtained on more than one rope.

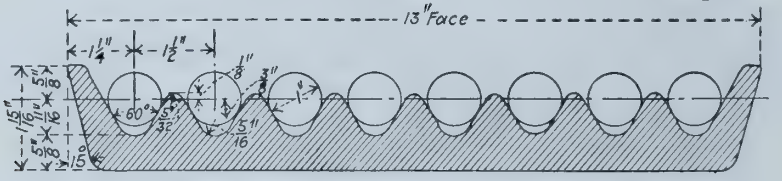
Groove Pitch Feature.

One of the greatest troubles in rope driving, when installed by inexperienced engineers, has been the lack of uniformity in pitch of the grooves where many ropes were used. This differential in the grooves compels slippage of the ropes which not only causes loss of power, but also rapidly depreciates the rope, and often causes the rope to flop around badly. To test the loss of efficiency in this case, two wheels 60 in. in diameter, of eight grooves each, were made up exactly alike so far as could be, and after most careful measurements the grooves on either wheel were found not to differ more than 1/64 in. in circumference from any other on the same sheave, and a test made. The driver was then removed, and the pitch diameter of each groove made approximately 1/32 in. less than the preceding groove so the eighth groove was ¼ in. less in diameter than the first one.

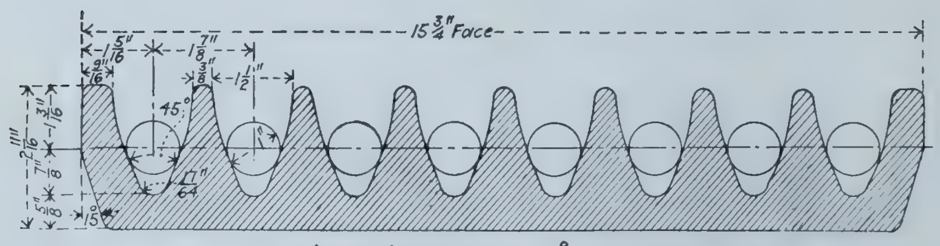
Again, it was placed on the driving shaft and a duplicate set of tests made. In this test as the first groove was ¼ in larger in pitch diameter than the eighth groove, with the sheave revolving at 160 r.p.m., there would necessarily be a slippage in an inelastic band of over ten feet per minute. The photographs taken of this differential drive, show plainly the sag of the various ropes under this condition, and how, under heavy load they stretch and slip in the grooves of the sheave. The elasticity of the rope in this case undoubtedly lends itself to aid efficient operation.

Test Procedure.

The "up and over" American drive was tested because it is typical of all but direct drives, i.e., straight from driver to driven, and the difference in efficiency between this type and the open drive will serve as a basis of comparison where but two additional right-angle turns are introduced requiring four additional idlers. This test was run on approximately 100 ft. centres with a new rope, the same rope being afterwards used in the testing of the various English drives.



American Standard 60° V-Grooves



Engineers' Standard 45° V-Grooves

FIG. 4. DETAILS OF GROOVES USED ON DRIVER AND DRIVEN WHEELS.

In testing the English drives, in order that proper comparisons be made, the ropes were all cut to the same measured length, and the splices carefully made, so that all ropes might be equally tight when applied to the sheaves. The movable tower was then carefully moved back, the rope being run slowly meanwhile until the sag in the rope was approximately the same as in the American drive of the same centre distance in which the slack rope was under a tension of 180 lb. This is undoubtedly a higher tension than is used in general practice on the English drive system with this size of rope, and the capacities and efficiencies shown are perhaps higher than are ordinarily attained in common practice. The efficiencies, when compared by speeds, of the English open drive show a marked decrease as the speed of the rope increases, falling as low as 84.5 per cent. at 5,500 ft. rope speed.

The general tendency in all tests made, both English and American, was corroborative of this tendency toward decrease in efficiency as the speed of the rope increases. There was, however, a lack of smoothness to many of the curves owing, it was thought, to variations in rope tension, and perhaps slight changes in the surface of the rope due to climatic changes. This was very much more noticeable on the English than on the American system, the irregularity of the curve on the former being affected by the fact that a greater load was sometimes attained on a certain speed than could later be reached on the next higher speed. The efficiency of the English drive, within the limit of distances tested, remains practically constant irrespective of centre distances; while with reference to number of ropes, it increases as does the American for the first few ropes, and then remains practically constant through the additional ones.

In order to test the effect of tension on the English system, a comparison was made by moving the receiving tower forward 1¼ ft. after making a series of tests, and then making another corresponding series. When sheaves with proper English pinch grooves, as shown in Fig. 4, were used, there was no appreciable difference either in power transmitted or in efficiency. Greater variations than 1¼ ft. in centre distances could not be satisfactorily tried because of the slack ropes dragging on the ground.

A new rope was used on the American open drive, another new one being started with the American "up and over," which latter was also used on both the English drives. The time of introducing the new rope is mentioned because it was found that a new rope had very much less capacity, owing to its low coefficient of friction, than the same one had after it had run a short time in work, and having less capacity it would usually have less efficiency also. The stiffness of the rope when it was new also seemed to add friction to the drive owing to the bending action in passing around the sheaves, which on the test were only 60 ins. in diameter. With larger main drive wheels, where the rope is not bent to so small a radius, the efficiency would undoubtedly be slightly increased over the results here shown.

Rope Drive Capacities.

The capacities of rope drives are affected by so many variables that no particular attempt is here made to state capacity other than in general figures.

Limiting capacities obtained are in no sense to be considered as available working capacities, but merely as limits reached in driving capacities, the practical working capacity being much lower than the limits reached. It is to be regretted that the power available was not great enough to get the larger capacities, as so few points were obtainable on the American open system. Even at the low speed of 2,500 ft. four ropes could not be made to slip with the 250 h.p. available.

The irregularities of these limiting horsepower capacities are caused by many variables, some of which are weather, surface conditions of rope, condition of rope wheel grooves, etc. In connection with the groove in the wheel, it was found that if a rope began to slip in a groove and warmed it up slightly, the coefficient of friction seemed to decrease very rapidly, and if a limiting test were made under these conditions it was invariably much lower than if it were taken just before the rope started to slip. As each test had to be taken in its scheduled order, some of those dealing with limiting capacities were taken at intervals of several weeks.

As the limiting capacities of the English drive are very much lower than the American, it is thought the efficiency is likewise affected, the friction in the former case being a much larger proportion of the power delivered. Again, the English system in order to get driving power in the rope, pinches it in the narrow groove, requiring considerable force to withdraw it again. This effort being exerted continuously uses up considerable power. The American system, on the contrary, uses a 60-deg. groove, in which the rope lies freely and withdraws without effort.

MODERN GEARING.

MR. H. HUBERT THORNE, in a paper read before the Junior Institution of Engineers recently on Modern Gearing, said: The subject had not received the serious consideration of many engineers, partly because of the belief (due to the very indifferently manufactured gears of even recent date) that all gears were inefficient, and partly because a very considerable amount of time must be given over to test and study if the subject were to be mastered. The involute possessed advantages over the cycloidal tooth for general use, as the centres of a gear could be varied to some extent, and still the latter would mesh properly. All that happened when the centres were extended was that the pitch point was moved nearer to the outside of the teeth, the pitches being correspondingly increased. This was a very useful property of the involute, and today this form was almost universally used; so, when speaking of gears, he would consider only involute gears.

The introduction of high-speed motors and the general speeding-up of machinery introduced new problems to the engineer, and he set about to find a gear which would run at a high velocity without undue noise and vibration, and one which would give a fairly high ratio of reduction in a single pair of wheels. Two ways of getting over the difficulty presented themselves—one by using pinions of special materials which would not create noise when running with metal wheels, and one by altering the form of the teeth. The former method was adopted for many drives, and pinions of raw hide, compressed paper, compressed linen, fibre, etc., had all been tried, but on account of the large diameters necessary to accommodate rivets between the bottoms of the teeth and the bore, the wheels became unduly large and heavy, and the ratios obtainable only small. The latter method had also been largely adopted, particularly within the last decade, and had resulted in the development of two distinct forms of gearing—the first worm gearing, and the second double helical gearing.

Worm Gearing.

Worm gearing was quiet in operation, and could be made with ratios as high or even higher than 100 to 1, but owing to the fact that the rolling action of the correct spur gear gave place to a rolling and rubbing action between the worm and the wheel, the speed of the worm must not exceed comparatively low limits, determined by the conditions under which it had to work; and, further, the efficiency went down as the ratio increased, and a high ratio worm gear was not by any means an efficient mechanism. The reasonable adoption of worm gears was consequently restricted to comparatively small powers, speeds and ratios. For such gears, having both shafts mounted in ball bearings, efficiencies of 95 per cent. were readily obtainable.

Helical Gearing.

For high powers and speeds some other form of gear must be looked for than worm gears. The single helical gear possessed the great disadvantage that end thrust was set up along the shafts (a disadvantage also inherent in worm gears), and to overcome this, two single helical gears of opposite hands were riveted or bolted together, thus forming the double helical gear. This type of gear, which was not now built up from two single helicals, but cut direct from the solid blank, was often manufactured with a ratio of 25 to 1 in a single reduction.

By comparison, the variation of stress on the teeth was very much less with the double helical than with the straight tooth, and consequently the former was the stronger. With double helical gears the average engagement was spread over an area, the limits of which were comparatively near the pitch line, and the action became more nearly a pure rolling one, and the rubbing action, which must produce wear, was reduced to a minimum.

With spur gears, particularly when the pinion had only a few teeth, a distinct knock was noticeable, as the load was repeatedly applied along the whole length of the tips of the teeth, whereas with double helical gears, however small the number of teeth in the pinion, the engagement at the top of the tooth could only occur at a particular point or points of the face at any one time, the average engagement being always near to the pitch line. Owing to the elimination of most of the losses due to sliding friction, practically the whole power put in was transmitted through the gear, and from actual tests it was ascertained that with a ratio of 20 to 1 in a single train, the efficiency was 98½ per cent.

Many double helical gears were now running at ratios of 25 to 1 and over, the only limiting factors being the diameter at the root of the pinion teeth, necessary to resist torsion and bending, the capacity of the machine on which the wheel was to be cut, and the space available. The diameter of the pinion was only limited by the necessary root diameter, because, as previously stated, by suitably increasing the face width of the pinion any desired number of teeth would be in engagement at one time.

ICE INFLUENCE ON WATER-POWER DEVELOPMENTS.

IT has been confidently predicted by a well-known engineer that at no distant date Canada will have not only transcontinental railways, but a transcontinental water-power system.

If this prophecy be ever fulfilled—and it would appear to be on the way—its realization will be in a large measure due to the work of men like Prof. H. T. Barnes, of McGill University, who gave a lecture last week, at the Engineers' Club, Toronto, on "The Influence of Ice on Water-power Developments."

Dr. Barnes is more or less of a theorist, and conducts his experiments chiefly from a scientific point of view, but his theories have proved very valuable in practice, and have been carried into effect in practical commercial undertakings. Mr. Murphy, of Ottawa, has admitted that some of the best results from experiments he has made in connection with power houses in winter have been based upon Dr. Barnes' theories.

The "Frazil" Trouble.

The problem which Dr. Barnes is at present engaged upon, and which he expounded by means of limelight illustrations, is to keep the great northern waterways open in the winter months. He showed by many photographs of ice formation in rivers and rapids how power plants were hampered by the accumulation of "frazil." This "frazil" is a formation which gathers in large, sponge-like masses in the beds of rivers, and rising to the surface, forces the upper ice above the water, and causes packing. Dr. Barnes' experiments included the idea of diagonal booms above the dam, and the forcing of hot air or steam on the surface of the water at the head of the dam.

He criticized the Government's handling of ice-breaking on the St. Lawrence River, and said that the Government thought they knew everything about ice-breaking. He declared that the present ice-breakers were useless, and that the Government had given an order for a new one to a firm that had never made an ice-breaker before.

Electrical Driving of Winding Engines and Rolling Mills *

By C. Antony Ablett, A.M. Inst. C.E. and H. M. Lyons, A.M.I.E.E.

Each inroad made by electricity into fields long held by the steam engine usually marks a distinct advance in engineering science. The authors show that the electrification of mine hoists and rolling mill machinery is not only fully as feasible as that of railways and other well-known applications, but that it has much greater flexibility in admitting of automatic control, safety devices, etc.

THE use of electrical machinery for driving hoisting engines in mines, and reversing rolling mill plants in steel works is comparatively recent; the first winders of importance having been introduced in 1902, and the first electrically driven reversing rolling mill being installed in 1906, though non-reversing rolling mills were driven electrically some eight or ten years earlier. The developments along these lines have been extremely rapid, as is shown by the fact that at the present time about one thousand large winding engines and nearly sixty reversing rolling mills are being driven electrically, and still greater developments may be expected in the future.

Under these circumstances a paper dealing with the modern aspects of the subject and giving the results of the experience obtained in the past would appear desirable.

The earlier winding engines were extravagant in power and had the disadvantage of drawing very heavily upon the source of electrical supply at the moment of starting. It was, therefore, impossible to use them on systems where the supply of current was limited, and even on comparatively large plants their use resulted in serious interference with other machinery. These disadvantages were, however, practically done away with when the Ward-Leonard system and Ilgner's adoption of the flywheel to this system were introduced, but the last few years have seen greater improvements in the Ward-Leonard and the Ilgner system. The present paper will deal chiefly with the development of these systems by the various Siemens companies, who have installed about half the total plants in existence, and with whom the authors have the honor to be associated.

Ward-Leonard System.

A short description of the so-called Ward-Leonard system, illustrated in Fig. 1, is desirable as an introduction. In this system a direct current motor is used to drive the winding engine or rolling mill, the motor being supplied with power from a direct current dynamo. The essential feature of this system is that the voltage supplied to the motor, and consequently the speed of the motor, is controlled by controlling the field current of the generator, instead of by varying the resistance in the armature circuit of the motor. Thus, as the field current of the generator is increased from nothing to a maximum, the motor speeds up from standstill to full speed, and if the field current of the generator is reversed, the motor reverses its direction of rotation. The system enables a very exact control of the speed to be obtained, because the speed of the motor is practically proportional to the strength of the generator field, whatever the load on the motor may be, while with any control system where resistances are inserted into the armature circuit of the motor, the speed would vary within very wide limits with a change of load rendering the exact speed control quite impossible.

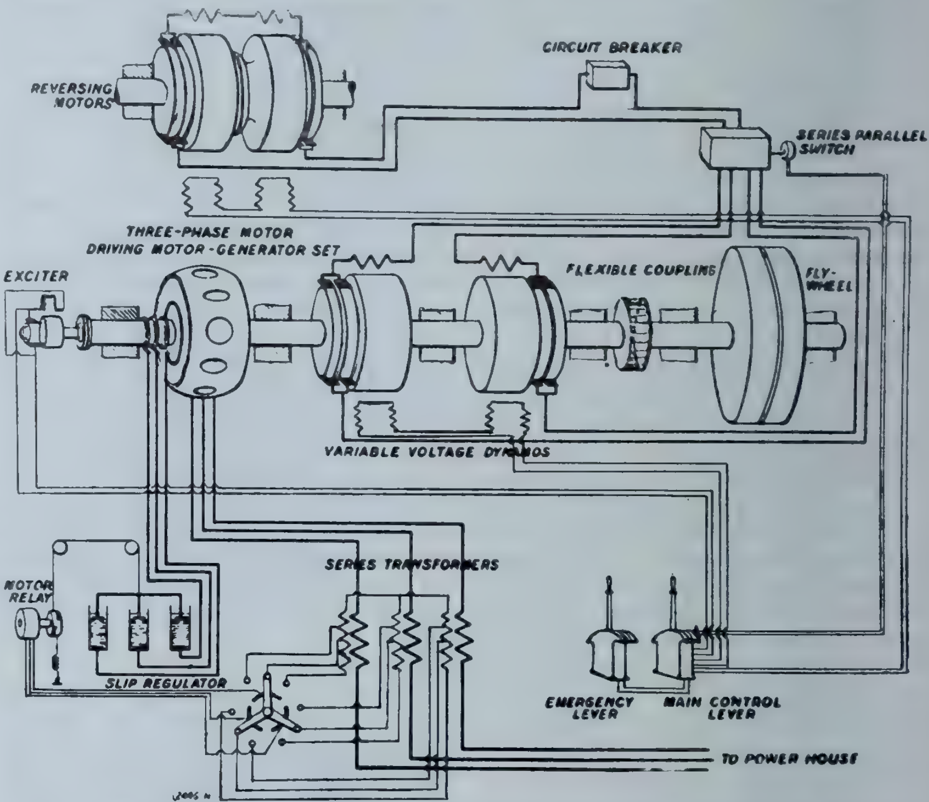


FIG. 1. DIAGRAMMATIC VIEW OF ILGNER SYSTEM OF DRIVING WINDING ENGINES OR REVERSING ROLLING MILLS.

The control of the dynamo field involves scarcely any waste of electrical power, but where resistances are inserted into the armature circuit, the loss of power may be, and usually is, very great. The field currents of the generator are small, so that the control mechanism is small, compact and very easy to handle; the armature currents are perhaps fifty times as great, so that any control mechanism which varies the resistance of the armature circuits is large, clumsy and difficult to handle, in fact a complicated relay system is often necessary to enable it to be handled at all. The dynamo used to supply the motor in the Ward-Leonard system is usually driven by a motor supplied from the available power circuit, forming a motor generator set, and this motor may be either direct current or three-phase, according to the power available. The dynamo may be and sometimes is driven by an engine, water turbine, or other prime mover, if this happens to be more convenient.

Application to Winding Engines and Hoists.

Speed Control. — The main control lever for operating the winding engine is coupled to the regulating resistance in the field circuit of the generator, so that when this lever is in the mid position there is no current in the generator field. As the lever is moved in one direction, the generator field current increases, and as it is moved in the other direction, the generator field current is also increased, but in the opposite sense.

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*Abstract of paper read recently before the Canadian Society of Civil Engineers, Montreal.

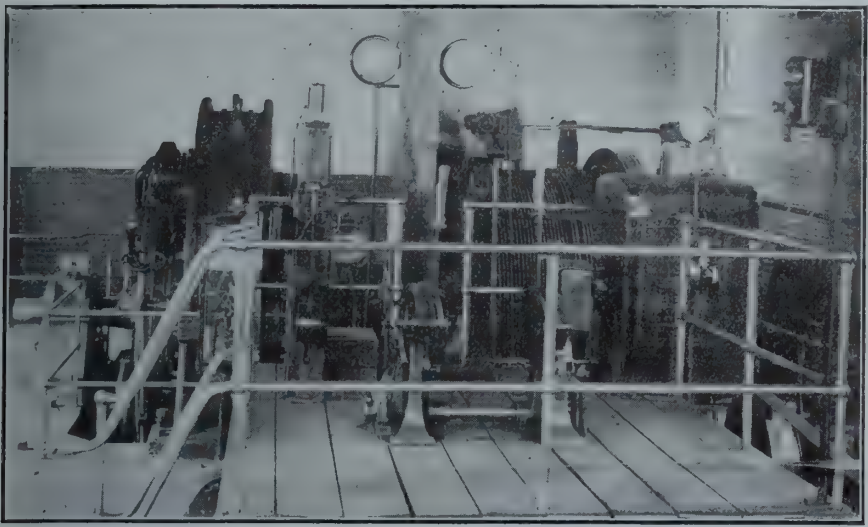


FIG. 2. WARD-LEONARD HOIST, LINGAN PIT, DOMINION COAL CO., SHOWING CONTROL LEVERS AND DEPTH INDICATOR.

From what has been said in the introductory remarks it will be seen that when the lever is in the mid position, the winding engine is at a standstill, and that it starts and speeds up as the lever is moved from the mid position in one direction, while, if the lever be moved from the mid position the other way, the winding engine increases in speed in the other direction, its speed being practically proportional to the displacement of the lever from the mid position, and not affected by the weight of material being hoisted. The driver has not absolute control over the speed, for two cams are provided on the depth indicator, one for each cage, which operate levers coupled to the control lever in such a way as to prevent the cages being accelerated at too rapid a rate, and to slow up the winding engine at the proper point so that the bank is approached at a crawling speed. Provided that these limits set by the cams are not exceeded the speed of the wind is entirely within the driver's control.

Use of Flywheel.

Fig. 4 shows the typical horse-power diagram for a winding engine. The inertia of the drums, cages, head sheaves, material wound, and the ropes, which altogether weigh about 60 tons in this particular case, necessitates a horsepower at the end of the acceleration period of each wind of 1865, which is about three and a half times the average power demand of the winding engine, in this case 524 horse-power, and it is found that the maximum acceleration peak is usually between three and four times greater than the average demand.

The consumption of energy for this Ward-Leonard control rises gradually during the starting period, and the maximum is only reached at the end of the time of acceleration, i.e., from ten to fifteen seconds after the start, because the speed of the winding motor is increased while it is giving the requisite turning moment by increasing the field of the generator, and consequently there is no loss of power in starting.

Since this acceleration peak is of short duration and only comes on gradually, it is possible to supply Ward-Leonard winders from power stations of comparatively small total output, provided that the machines in the power station have a sufficient overload capacity to maintain their speed during peak loads, as is usually the case with steam turbogenerators where the generators are provided with modern voltage regulators.

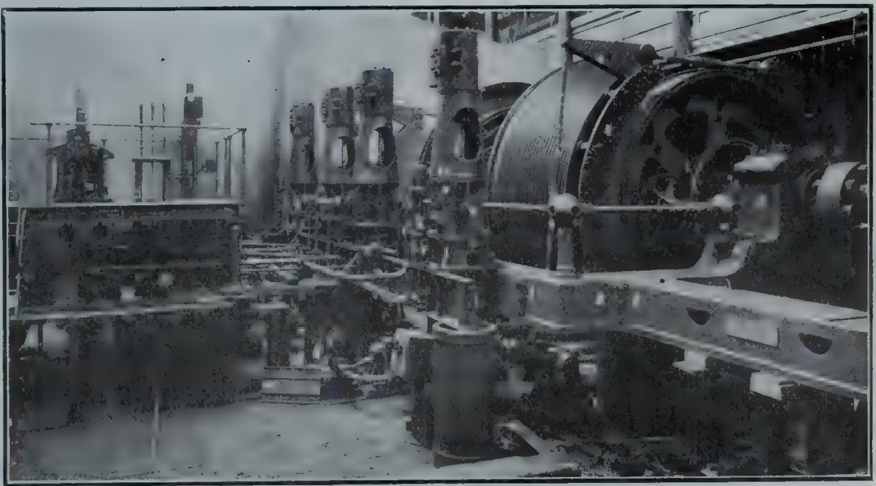


FIG. 3. CONICAL DRUM WARD-LEONARD WINDER, AT THE CANADIAN COLLIERIES COMPANY'S CUMBERLAND COLLIERY, SHOWING BRAKE GEAR AND CONTROL LEVERS. DEPTH, 1,000 FEET; NET LOAD PER WIND, 3½ TONS.

Where, however, this is not the case, and the acceleration peaks of the winding engine are large compared with the average demand on the power station, or where the winder is supplied through a long transmission line from a distant power station, it is sometimes necessary to couple a flywheel to the motor generator set. In this case provision must be made so that during a peak load the motor generator falls in speed, enabling part of the stored energy of the flywheel to be used to supply the heavy demand, and, when the load is small, the motor generator set is speeded up again, the surplus power being taken to restore the energy of the flywheel, so that the demand from the power house or supply system is maintained at about the average. This is the Ilgner system, so-called after the engineer who first used it in practice.

Fig. 5 illustrates the effect of the flywheel in equalizing the load taken by the winder. It will be seen that the current taken by the winding motor varies between +1900, and—1,000 amperes, while the current taken from the supply system is maintained practically constant at 400 amperes, the maximum voltage supplied to the winding engine and the supply voltage being the same.

The following example will give an idea of the power taken by the Ilgner system under practical working conditions with a winding engine arranged to wind 240 tons per hour from a depth of 1,960 feet, making as a maximum 44½ winds per hour, where the flywheel is used whenever the full output is being wound at the full speed, but where a lesser output is being wound at reduced speed, so that the acceleration peaks become less serious, the flywheel is uncoupled to save power. These results are conveniently expressed in terms of the kilowatts taken by the electric winding engine plant per shaft horse-power.

	Output tons per hr.	K. W. per S.H.P.
With flywheel	240	1.49
"	160	1.60
"	108	1.77
Without flywheel ..	160	1.35
" ...	108	1.48

It will thus be seen that, when working the winding engine on the Ilgner system, there is an increased loss of power of from 16% to 17%, as compared with the Ward-Leonard system, and, naturally with the latter where the flywheel is uncoupled, the resistances are cut out of the rotor circuit of the three-phase motor to avoid loss of power.

To avoid misunderstanding of the above results, it should be specially pointed out that shaft horse-power (S. H.P.) is taken to mean the actual work done in raising the load, i.e., if the actual weight of coal or ore, expressed in lbs., which is raised per minute be multiplied by the depth of the shaft in feet, and divided by 33,000, the shaft horse-power is obtained. The shaft horse-power thus does not include the mechanical friction of the winding engine, the sheaves, the guides or the rope losses, and the figure of the kilowatts divided by the shaft horse-power brings in the mechanical efficiency, as well as the electrical.

Details of Ilgner System.

Flywheels are usually designed to equalize the load by falling in speed from 15 to 20 per cent., and it is found that this entails a loss of power in the slip regulator of about 7½ per cent. to 10 per cent. The flywheel is usually coupled to the motor-generator set by means of flexible coupling, though in some very recent Ilgner motor generator sets, where there happens to be no advantage in running with the flywheel uncoupled, the electrical machines and the flywheel are arranged to be carried by two bearings only, reducing the first cost and the friction losses.

Of recent years, the capital cost of Ilgner plants has been greatly reduced, owing to the adoption of higher speed for the motor generator sets, and to the improvements in the manufacture of such flywheels, which enable them to run at very high peripheral speeds compared with those used in the earlier winding engines. For example, the provision of flywheel capacity to equalize peak loads of 60,000 horse-power seconds, in the early days of Ilgner winding, where peripheral speeds of 15,000 feet per minute were used, would require two flywheels of a total weight of about 80 tons, the friction and windage loss of which would be about 150 horse-power. Under modern conditions where the regular peripheral speeds are 27,000 and 30,000 feet per minute, a single flywheel of 22 tons weight would be used, instead of the two flywheels having a total weight of 80 tons, and the friction and windage losses would not exceed 100 horse-power.

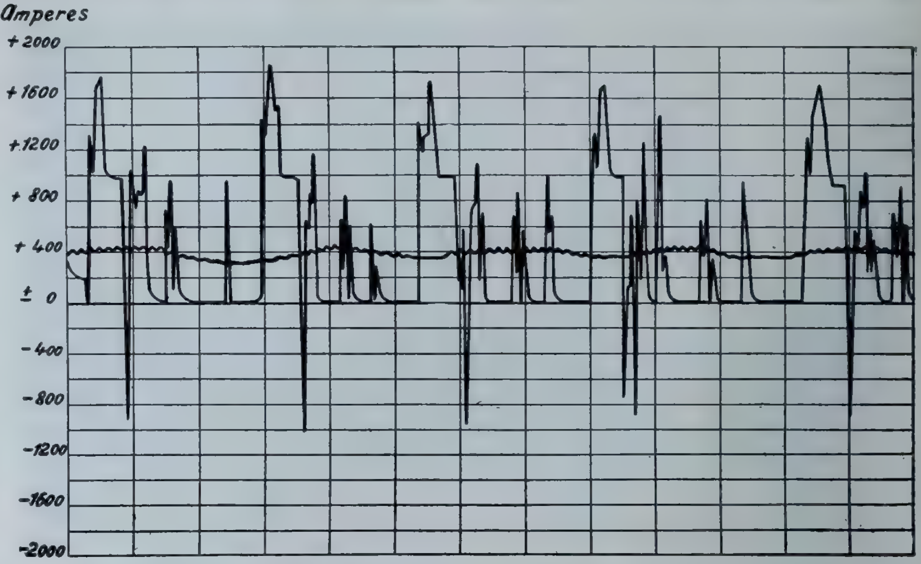


FIG. 5. DIAGRAM SHOWING THE EQUALIZING EFFECT OF THE FLYWHEEL ON ILGNER'S ADAPTION OF THE WARD-LEONARD SYSTEM. THE WAVEY LINE AT ABOUT 400 AMPERES IS THE CURRENT TAKEN FROM THE SUPPLY SYSTEM. THE CURVE WHICH SHOWS THE GREAT VARIATIONS REPRESENTS THE CURRENT TAKEN BY THE WINDING ENGINE.

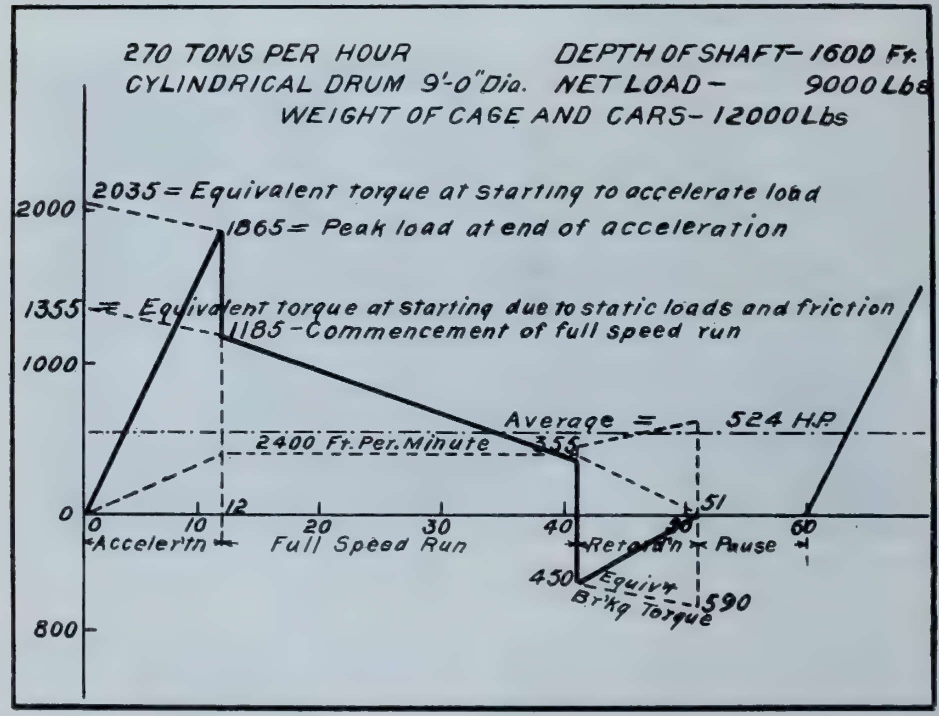


FIG. 4. TYPICAL POWER DIAGRAM FOR A WARD-LEONARD WINDING ENGINE.

The Ilgner system was used on practically all the early European winding engines, but as at the present day, power stations are being installed of much greater capacity than those of a few years ago, and high speed turbo-generators of large overload capacity are being adopted, the Ward-Leonard system at the present time is being used to a much greater extent than the Ilgner system for winding engine work.

The Systems Compared.

Generally speaking, the Ilgner system of winding may be preferable to the Ward-Leonard system in the following cases:—

(1)—When the time occupied by the wind is short.

(2)—For vertical shafts.

(3)—For large outputs.

(4)—Where the winding speed is very high.

The above conclusions may be considerably modified by the nature of the electrical supply. Where the power station is small or the winder is supplied through a transmission line of considerable length, the Ilgner system will be more suitable, but where the power station is large and near the winder, the Ward-Leonard system is the better. Where there are a number of winding engines supplied from the same power station, the Ward-Leonard system would prove very suitable, because the combined effect of these winding engines working together will be to reduce the percentage of fluctuations on the power station load. Fig. 6 gives an illustration of this principle, and shows a case where three rolling mills are supplied from a single power station, and although the load of each one varies about 73 per cent., the total fluctuation in the power station load is about 28 per cent.

Brake Gear.

The mechanical brake is so arranged that, when required to be brought into action, it is actuated by a weight at the end of a lever, but normally held off the drum by an air cylinder. Under normal conditions the cams on the depth indicator actuate the control lever, so that the cages approach the bank at a very slow speed. When they reach the bank, the driver brings them to rest by means of his control lever, and then puts on the mechanical brake to hold the cages in position by means of the brake lever. The brake lever is interlocked with the control lever, so that the driver cannot put on the brake by means of the brake lever until the control lever is at about its middle position, i.e., unless the cages are moving at a comparatively slow speed.

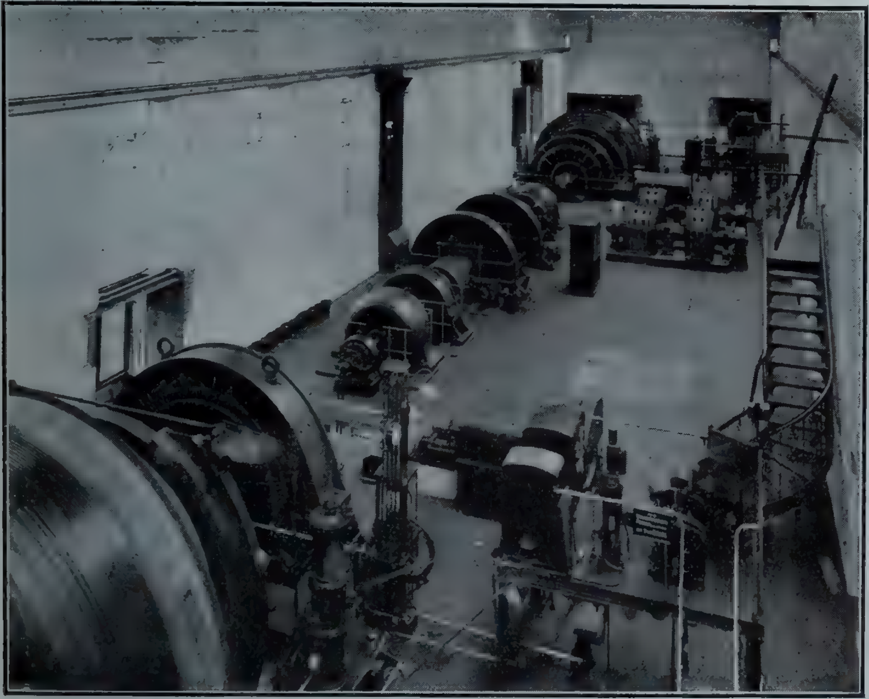


FIG. 6. GENERAL VIEW OF WINDING ENGINE EQUIPMENT, MARKHAM STEAM COAL CO. PLANT, SHOWING BOTH WINDING ENGINES.

To enable the driver to stop the winder in case of any emergency arising, a third lever, the emergency lever, is placed on the driver's platform and, if this be operated, it puts on the mechanical brake through the emergency gear and at the same time cuts off the excitation from the dynamo of the motor generator set.

Safety Devices.

From what has been said, it will be seen that the brake is applied by the positive action of the weighted lever, and, if the air pressure should fail, the brake is promptly put on. The armatures of the winding motor and the generator are permanently connected by heavy cables, and there are no cut-outs or switches in this circuit, so that the circuit between the armatures cannot be interrupted; electrical braking is always available as well as the mechanical brake, unless the excitation should fail.

As mentioned above, cams are provided on the depth indicator which keep the acceleration within safe limits, and the cage is brought gradually to a slow speed by the time it reaches the bank. An overwind device is provided, usually both on the depth indicator and in the shaft, which puts on the mechanical brake through the emergency gear and cuts off the excitation should the cage overwind the bank, thereby bringing the winding engine instantly to a stop. Should the air pressure or the excitation fail, the mechanical brake is put on by means of the emergency gear. When men are being wound the throw of the main control lever is limited by means of a switch on the bank, so that the winding engine cannot be run above a certain speed.

Where electrical driving is adopted, it is very easy to provide safety devices, and all those mentioned are designed to protect the plant against careless handling, but if the majority of safety devices were dispensed with, the Ilgner and the Ward-Leonard winder would still be better protected against careless handling than the steam winder. The fact that it is impossible for an Ilgner or a Ward-Leonard winder to race or run away makes it inherently safer than the steam winder.

EXPERIMENTS ON ROPE DRIVING.

VERY extensive experiments have recently been conducted under the auspices of the Society of German Engineers at the Charlottenburg laboratory. These researches cover a wide field, and of especial interest are those which relate to the influence of velocity. The efficiency in per cent. is given under various tensions, showing a considerable decline at low loads. With a tension of 286 pounds in a rope of two-inch diameter, which is sowewhat below the tension of 200 pounds per square inch commonly employed in calculations, the efficiency is 98 per cent. at 2,540 feet per minute and 96 per cent. at velocities of 7,680 feet per minute.

These experiments conform so nearly with discoveries which were made many years ago as to make it fairly certain that with a properly designed installation and with a good grade of cotton rope the high point of efficiency, which by many tables is indicated to be at from 4,500 to 4,800 feet per minute, may be moved a considerable distance beyond these figures. They also indicate that rope drives can be used to advantage at much higher speeds. Another matter definitely established by the Charlottenburg tests is that idler or jockey pulleys produce a marked loss in efficiency.

The evidence from actual experience, as well as from tests, indicates that it is safe to use proper installations of rope drives up to 7,000 feet per minute, and that the power up to this speed will be approximately in direct ratio to the increase in speed. As an example, it may be mentioned that nine ropes of two-inch diameter are regularly conveying a normal load of 880 horsepower at 7,200 feet per minute in a large steel works in Germany. This is double the amount allowed by many tables in which too much allowance was made for centrifugal force by the compilers. It therefore would appear that the high speed permissible with rope drives is not limited so much by the rope efficiency and endurance, as by the material in the pulleys being able to resist the centrifugal stresses.—Machinery.

The Application of Chain Driving to Textile Mills

By H. T. Hildage, M. Inst. C.E.

About two years ago experiments began to be made in Lancashire, England, on the suitability of Bush Roller and Silent Chains for transmission purposes in textile mills. The new method quickly gained favor, and the present extract from a paper read before the Textile Institute in Manchester gives particulars of numerous typical applications of this latest form of mill drive.

IT WILL be difficult, if not impossible, to convey an adequate or accurate impression of the extent to which chain driving has been adopted in textile mills. Generally speaking, the tendency has been to resort to this form of transmission only in cases in which other forms of transmission, for some reason or other, are not suitable or have given trouble. The idea that chain driving is a standard method of transmitting power, of very great value, and of almost general applicability; that it ought to be considered whenever a new plant is being put down, or an old one remodeled, has not received proper recognition either from engineers or from textile manufacturers, and it is only when chain manufacturers have been unusually pushing, or when consulting engineers or mill owners have been unusually enterprising, that the matter has been considered in this way. It can be assumed, however, that in every one of the cases mentioned hereafter, the application of chain gearing has been thoroughly tested and found satisfactory, and may therefore be regarded as one of the standard drives for the future. It will be convenient to arrange these cases under separate headings.

Driving Lineshafts in Spinning and Weaving Factories.

In only a few cases has chain gearing been used to drive direct from the engine to the lineshaft, and in these cases the power has not usually exceeded 100 h.p. It has, however, been very extensively used for driving from electric motors to lineshafts, and its suitability for this purpose has been very completely demonstrated. Perhaps the best example for us to take now is the electric conversion of Mr. Robert Clough's mills at Keighley, Yorkshire, carried out by Mr. W. O. Pepper.

A cross-compound Corliss engine driving by ropes to the head shafts in the usual way was replaced by a turbo-alternator as a prime mover and electric motors as transmitters, without any other alteration in the structure or arrangement of the factory. In every case the shafts were driven from the motors by means of silent chain gearing, and specialists in chain transmission were consulted from the outset, and, as far as latitude was possible, arranged the drives so as to be entirely suitable for chain gearing. Fig. 1 shows a typical drive. The conversion was carried on without any interruption whatsoever to the daily work of the factory. The chain wheels were mounted on the shafts alongside the rope pulleys, and no other

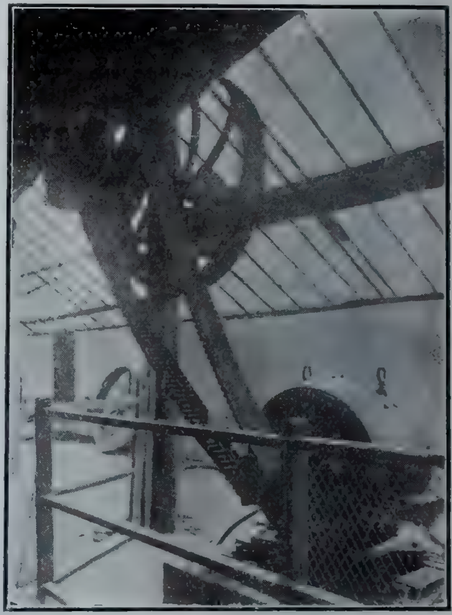


FIG. 2. 90 H.P. CHAIN DRIVE.

FIG. 1. 75 H.P. SPINNING ROOM DRIVE (CHAIN RUNNING).

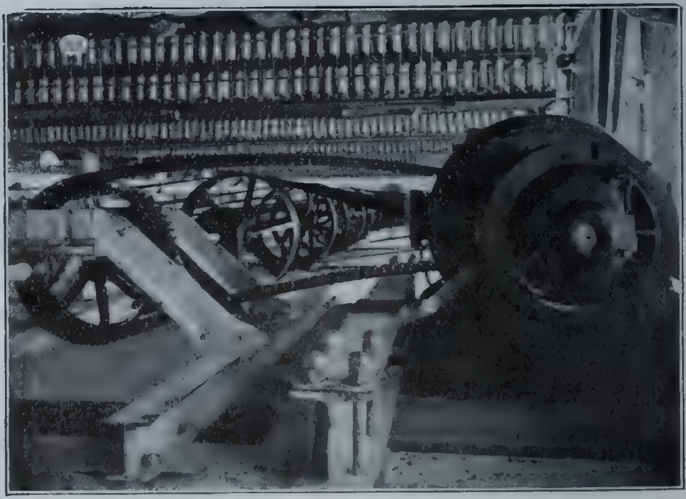


FIG. 3. CHAIN DRIVES IN FLAX SPINNING FACTORY.

alteration to the shafting or mill gearing was made. This fact is of some importance in considering the remarks that follow concerning uniformity of turning, and the descriptions of the tachograph records.

In April, 1911, when these mills were still running under the old conditions, a series of tachograph diagrams were taken from the shafts near the rope drives, and in March, 1913, after the mills had been running for some time with electric power, a further series of diagrams were taken from the same shafts near the chain drives. It was found by a comparison between the tachograph records taken in the same place, on the same shaft, before the conversion and after, that the cycle variation was very much reduced. The comparative figures are given in the following table:—

Where taken, and nature of load.	Per cent. Speed Variations.	
	Rope and Reciprocating Engine.	Chain and Motor.
Near engine, spinning room, second floor, steady load	.5	.0
Further from engine, spinning room, fourth floor, steady load............	1.2	.0
Near engine, weaving shed, fluctuating load	4.5	.5

Note.—The author here introduces a number of tachograph diagrams, which lack of space forbids our reproducing in **The Power House.** They are chiefly of interest to experts, and serve to show in a graphic form the great improvement brought about in the regularity of turning by the installation of the turbo-alternator set combined with chain drives. One of the inferences to be drawn from the diagrams is that where steadiness and even turning are of importance, it is advisable to place the motor and chain drive as near the middle of the shaft as possible. After discussing the diagrams at some length, the author continues as follows:—

As Mr. Clough's installation embodies many novel features, it has naturally been kept under close observation by those directly interested, and now, after considerably more than a year's running, it is possible to say that, as far as chain gearing is concerned, the results have proven even more satisfactory than was originally anticipated.

Another rather interesting drive is shown in Fig. 2. This is a 90-h.p. drive in the central finishing works of the Calico Printers' Association. The shaft was originally driven from the same motor by a belt, through a first reduction in spur gearing. It is obvious that, had chain gearing been used in the first instance, there would have been a considerable reduction in the first cost of the drive, and it is possible that some of the space occupied by the belt drive might have been used for other purposes.

Another drive that is interesting, because it shows another form of construction, is Fig. 3. This is in a flax spinning factory, and the looms were formerly driven—before electrification —by vertical shafts and bevel gearing. After electrification spur drives from the motors were first used, but the vibration and noise was so great that they had to be taken out.

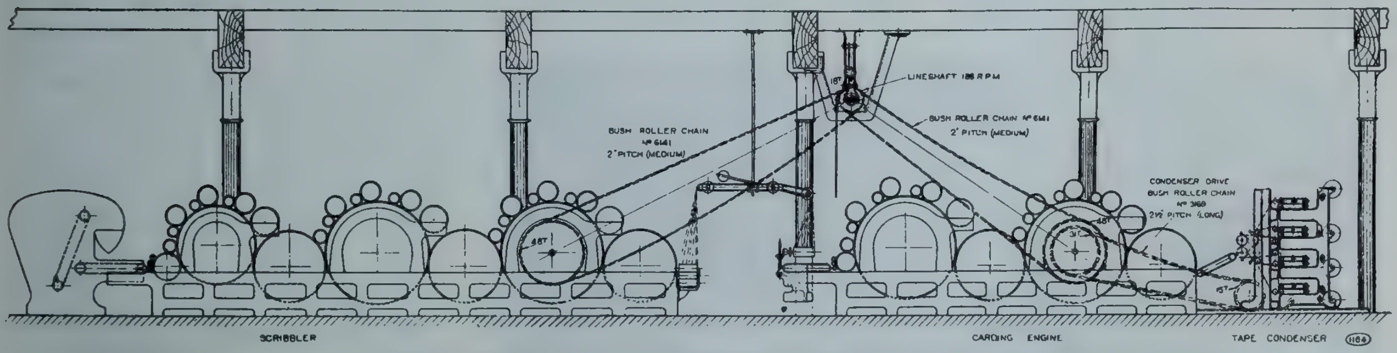


FIG. 4. CHAINS DRIVING SCRIBBLING AND CARDING MACHINES.

Driving from Lineshafts to Machines.

For several reasons the substitution of chains for belt driving from line shafts to machines has not been very much taken up by textile manufacturers. In the first place, it is rather a radical proceeding, and mill owners are conservative. The advantage to be obtained from a single substitution appears very small, and extensive substitution could naturally only be taken up after experiment and experience. Chain manufacturers, on the other hand, have not devoted much attention to pushing this kind of business, because in the present state of the knowledge of chain gearing they realized that they had tremendous difficulties to overcome, and a much more natural line seemed to be to push the sale of heavy drives, which gave them the business that they wanted immediately, and served a useful purpose in educating those interested in the subject of chain gearing. There is no real reason, however, why it should not be taken up very extensively indeed, and with very great advantage. There are some cases which present no difficulty whatever, from a chain point of view, and immediate benefit would be obtained.

One of the cases in which it has been applied is of striking interest to woolen manufacturers, namely, the driving of scribbling and carding machines. The designers and builders of these machines have been at very great pains to insure that all the various swifts of each unit should be connected up by a positive transmission, for the obvious reason that the product of one unit is the raw material of the next, and must consequently be supplied at exactly the correct rate. In other words, each unit must be capable of taking the product of the machine before it, just as fast as it is produced. In spite of this obvious necessity, and the great pains taken to meet it, the units are usually connected to the lineshafts by belts, and the condenser connected to the swift of the last unit by belts or bands. These belts or bands, which all slip to some extent, are often of different lengths, and differently loaded, and even if they were all the same length and equally loaded, their condition, as regards the presence of "fly," or as regards tightness, would cause them to slip differently.

Messrs. William Lawton, Ltd., of Huddersfield, were the first to conceive the idea of using chain gearing for the purpose of driving these machines. They tried it on one set in their own mill, with entire success. A comparison was made between this set of machines, and another set with belt drives, running under, as far as possible, identical conditions, for a period of 21 days, and there was found to be an increase in production of 4.3 per cent. Mr. Lawton also said that a considerable improvement in the quality of the material was found, which showed itself in the reduction of the number of broken ends in the spinning room.

In a more recent case, when the change was first made it was found, after 15 minutes' running, that the scribbler was overmaking the carding engine, and the feed into the latter had to be speeded up 7 per cent. In the two days previous, the feed on this particular machine had to be changed four times to allow for the varying slip of the main belt on the scribbler. During five hours' running, after the conversion to chain driving, two ends came down in the condenser, whereas the average before the conversion was made was in the neighborhood of three per hour.

No modifications of the arrangements in the carding room are necessary for the purpose of making this kind of conversion. A friction clutch mounted on the lineshaft is substituted for fast and loose pulleys on the machine, and it is desirable, on account of the heavy starting torque, to use a gradual engagement device for operating the clutch. The chains can then simply take the place of the belts. A typical example is shown in diagram Fig. 4.

An example of driving from the main shaft to a small auxiliary countershaft for mules is shown in Fig. 5, while Fig. 6 shows some calender drives that were installed in the year 1907. These are still running, and giving great satisfaction.

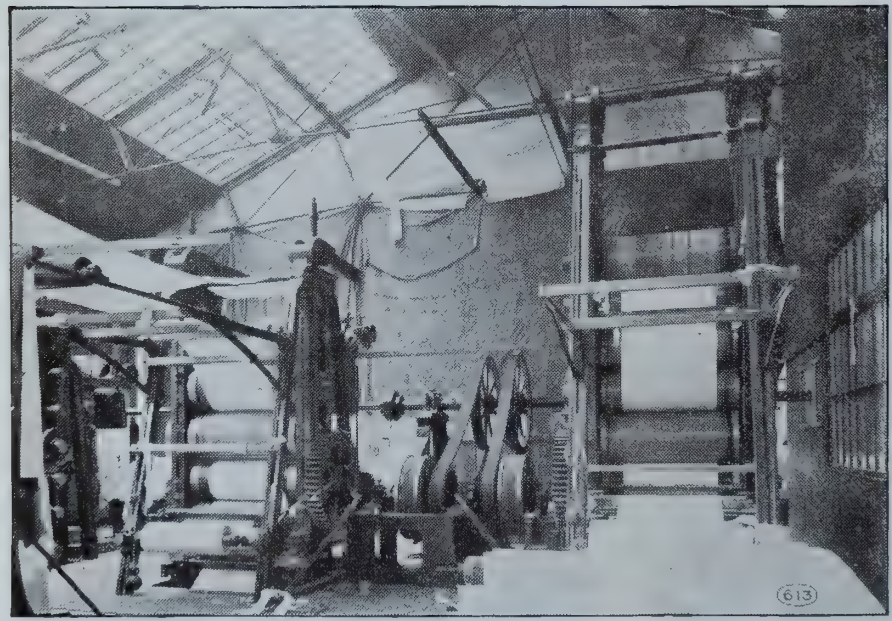


FIG. 6. CHAINS DRIVING CALENDERS, INSTALLED 1907.

The next example really lies half-way between driving from lineshaft to machines, and driving from individual motors to machines. It is the case of the installation of the Seedhill Finishing Co., of Paisley, Scotland. Generally speaking, the machines are arranged in pairs, and the driving is from a motor to a countershaft for two machines, and from this countershaft to each of the machines.

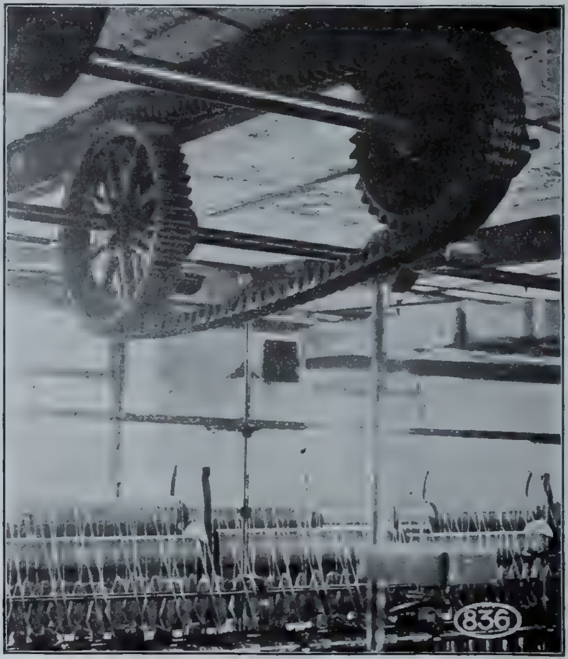


FIG. 5. CHAIN DRIVING FROM MAIN SHAFT TO COUNTERSHAFT FOR MULES.

About the middle of October, 1912, the works of this firm were completely gutted by fire, and in December of the same year arrangements had been made to recommence building them on entirely new lines, incorporating all the latest improvements. Plans were made for work to be re-commenced by May 1st, 1913, and actual pieces of material finished in the new works were being delivered in Lancashire by May 6th, 1913.

We are indebted to Jones & Glassco, Montreal, for the illustrations accompanying this article.

* * *

Change of Name.—On and after September 1st, 1914, Jones Cold Store Door Co. will change its corporate name, and will thereafter be known as the Jamison Cold Storage Door Co., Hagerstown, Maryland. No change whatever will be made in the organization or the business of the company, and the personnel of the management, the sales and shop force will be the same as it has been since 1907. The change of name by the Board of Directors was made in compliment to the Jamison family, whose absolute control and management has directed its affairs to its present world-wide fame in cold storage doors. No change has been or will be made in the trade names or trade rights, and all the property and rights which they now possess will continue and be used in the catalogue and all of the advertising matter.

* * *

Gas Engine Troubles.—I am of opinion that W. M. Grey's trouble is in his engines and not in the generators. I think the trouble is due to the mixture or the governor, with possibly a little ignition disorder. There might even be a combination of any two of these. If Mr. Grey would state when his engine stops; that is, whether at light load, full load, or over-load, also what kind of fuel he uses and the type of ignition, it would be possible to give a definite opinion of some value to him.—H. W. Benton.

Elements of Power Transmission -- The Belting Feature

By J. Pedie Sanderson, B.A.Sc.

The necessity of a fully competent man to supervise the care of belts is often one of the things about a plant that are so obvious as to be little thought of. Like the engineer who is asked: "Can you start an engine?" and the fireman who is hired for his ability to transfer coal, this man's necessary qualifications are often fulfilled by an affirmative answer to the question: "Can ye fix belts?"

IN spite of the many improvements recently made in electrical transmission and the great advances achieved in other forms of power transmitting mediums, belt drives are still the most suitable for a fairly wide range of conditions, and their apparent simplicity is inclined to cause their popularity to remain with engineers for an indefinite period of time.

The initial cost of a belt transmission is about one-fourth that of an electrical transmission where the conditions are suitable for the former system, but where the drive is such as to cause more or less rapid deterioration of the belt material, the balance of favor goes to the electrical drive. A leather belt drive costs nearly twice as much as a rope drive, and more where large powers are to be handled for considerable distances. Rope drives, however, unless great care is exercised in their construction are very much less economical.

Rope Drive Comparisons.

As the ropes wear they become uneven in diameter and some parts fall more deeply into the V-shaped grooves of the sheaves than others, causing different speeds in different sections of the rope. This sets up a sort of differential drive which causes a difference in rope tension and may even cause some ropes to be tighter on the slack side than on the intended tight side of the drive, and consequently producing negative work. Leather belts can be efficiently spliced much more easily than cotton or rubber belts, and the splicing up of a rope drive is a very considerable undertaking in comparison.

Abuse of Belts.

The value of a belt transmission rests in its durability and efficiency, two qualities almost entirely at the mercy of the treatment which is accorded it. A particular case came to the writer's notice about ten years ago. A three-inch leather belt was placed upon the cone pulley drive of a lathe and, on account of poor alignment and rough usage, had to be replaced with a new one in less than six weeks. Before the new one was put on, however, the pulleys and shafts were correctly lined up with the result that it is still running and rendering good daily service.

The strangest feature in connection with the supervision of belting considering its importance to the continuous and efficient operation of machinery is the fact that, in a great majority of plants, its care is either entrusted to no man in particular, or to some one who has been found to be unsuited for anything else. How often one sees an important drive made up of from three to six pieces of belting of various ages and thicknesses fastened together with leather lacing, wire, and perhaps a number of patent metallic fasteners. The operator in many cases, patches or fixes his belts with whatever he can get, and gives them no further thought as long as his machine keeps going. He rarely has more than a rudimentary knowledge of this class of work.

Belting Organization.

The belting of a plant, no matter how extensive, should be placed in charge of one man, preferably one who has gained his experience in a factory where belts are made, and who with his understudy should in company with others connected with machinery maintenance, be under the direction of the chief engineer or master mechanic. It is only in this way, and seeing that the belt man does his work, that dependable records of belt performances can be kept and efficient systems of inspection be carried out.

Tension Measuring Machines.

By far the most important point in connection with the care of belts is tension properly set and maintained. There have recently been devised and placed on the market several appliances for accurately measuring the tension of belts. One of these is the belt bench which is provided with spring balances and other requisites so that belts can be periodically removed from their machines and be brought to the bench for inspection and repairs, and have their tensions weighed. This is to be advised where the number of belts will warrant the expense, although a great deal can be accomplished by an intelligent man without its use. To supplement the use of the bench, which is limited in its application, there has also been perfected a portable device for measuring the tensions of non-removable belts while in place. As this is applicable only to small belts, and is rather inconvenient to use in some belt situations, it has not, so far, proved very useful.

Proper Tension.

The most suitable tension of a belt is an extremely variable quantity. It should be adapted to its position and to the work required of the belt. The less the tension can be made within reasonable limits without causing slipping, the longer will be the working life of the drive. The experience and judgment of a man suitable for this work has, so far, been found to be the best authority for setting belt tensions.

Belts should be made endless; that is, lapped and cemented together whenever possible. In smaller ones, it is often necessary for convenience in caring for them to have one inferior joint in its length, but there is no excuse for more. This joint should be intelligently made with leather lacing of the proper proportions. Patent metallic fastening devices should be used with caution as a number of them have been found to be worse than useless.

Stretch.

The average leather belt stretches from 6 to 8 per cent. of its original length during its lifetime, and most of this takes place during the first six or eight months of its active use. After this, the stretch is small and uniform until all elasticity is lost.

The method of procedure then for a moderately large belt would be to cut it from a foot to three feet too short, depending upon its size and length. It is then laced up with a carefully made patch which can be periodically shortened until the greater part of the stretching process is finished. A permanent patch is now cemented in and the drive will require attention only at long intervals of time thereafter.

It is well known that a lapped and cemented joint will last more than twice as long as any other, besides running more smoothly and in fact, it can be made as strong as the body of the belt. When the simplicity of making a first-class cemented joint is known it is surprising that it is not more generally used. The requisite tools are comparatively few and inexpensive, as it is possible for an intelligent man to make most of them for himself.

Cementing a Joint.

Before cementing a joint, the belt should be placed over the pulleys and the proper tension obtained by means of clamps. Care must be observed to fasten these clamps squarely across the belt and to locate them centrally with it before drawing them up with the threaded rods along the sides. After drawing the belt a little tighter than is desired to allow for slack, place a smooth board under it between the rods and bevel the ends to form the lap. Apply the cement while very hot, but not boiling, and not too thick, rubbing it in thoroughly. On large belts, it is better to cement a few inches at a time, rubbing and hammering each part down by itself, and so proceeding until the joint is completed. The clamps should remain in position for at least an hour or as long as convenient. Small and medium-sized belts can be readily clamped with C clamps between two smooth boards to which they have been tacked in the proper position. The length of the lap should vary with the width of the belt, general practice being given in the folowing figures:—

Belt widths in inches....	2	3	4	5	6	7	8
Length of lap in inches..	5	6	6	7	8	8	9

For widths of 9 inches to 18 inches, the lap is made equal to the belt width. Above 18 inches, the length of the lap need not be greater than this.

Direction of Lap.

The direction of the lap should be such that, in a single belt, the leading edge of the lap should be on the inside or next the pulley. In a double-ply belt, the same rule applies with regard to the outer layer. The trailing edge of the inner ply, however, should be next the pulley which gives the joint the form of a broken V with the vertex pointing in the direction in which the belt is intended to travel.

Friction is much greater between similar than between dissimilar substances, hence much is to be gained by covering pulleys with leather. This allows a greater horse-power to be transmitted without increasing the tension of the belt, as well as to greatly reduce the tension necessary to transmit a given horse-power. To cover a pulley with leather, make the covering in the form of an endless ring whose circumference is about ⅛ inch to the foot less than the circumference of the pulley. Clean the surfaces of all grease by washing with benzine, naphtha or similar substance. Start the pulley into the ring and cover with a special glue both the inside surface of the ring and the exposed surface of the pulley. Quickly drive the cover over the pulley by lifting it, and striking the cover edges against the bench or floor. When in place, rub the cover thoroughly with a smooth hardwood stick or hammer handle to insure perfect contact, particularly around the edges. If properly done, no pinning is required although it is customary to insert a few copper rivets.

Choice of Belts.

Narrow, thick belts are much more desirable than wide thin ones, especially for long drives. According to Mr. F. W. Taylor, whose experiments cover a continuous period of over nine years, it is advisable to use double belts on pulleys 12 inches or over in diameter and triple belts on pulleys 20 inches or over. This is for the purpose of giving a sufficient stiffness to prevent snapping and waving on the slack side when running at high speeds which is often more injurious than the actual work the belt has to do. This stiffness should also be sufficient to prevent side travel which becomes excessive when belts are long and the load variable.

Belt Calculations.

The satisfaction of belt drives is greatly increased by their proper proportioning.

To find the width of belt necessary when the horse-power required to be transmitted is known.

Multiply the horse-power by 33,000 and divide this product by the product of the belt speed in feet per minute multiplied by 55 for single, 83 for double or 110 for three-ply belts.

The constant 55 depends upon the arc of contact of the belt on the pulley and varies greatly according to different authorities, that is, all the way from 30 to 65. The above, however, is a reliable figure and is for cases where the arc of contact is approximately half of the pulley. When the arc of contact is not 180 degs., the "effective pull" can be found by multiplying the arc of contact by 55 and dividing the product by 180. Multiply this by 1.6 for double belts and by 2 for triple belts.

Inspection.

The belt man should carry out careful and systematic inspections of all belting at frequent intervals and keep a record of his work. Inspection should be such as to determine if any of the following conditions exist:—

(1)—Whether belting is over-dry or saturated with oil.

(2)—If any laps have begun to open.

(3)—Whether belting is working under proper tension.

(4)—Whether shafting is in line or if a guide has to be used to keep belts on the pulleys.

(5)—Whether afflicted with an overdose of dressing.

General.

Greasy or unduly dry belts should be thoroughly cleaned, the former with naphtha or benzine is necessary, and the latter may have to be scraped free of surface dirt. When a clean surface is obtained, both sides should receive a light coat of approved dressing. These applications should be repeated judiciously until that mellow but not greasy feeling characteristic of proper working condition is obtained.

If laps have begun to open, they should first be thoroughly cleaned with some degreasing substance such as naphtha and re-cemented, not tacked or riveted. If shafting be out of line, the sooner it is fixed the better for the machine as well as the belt. The tightness with which belts are put on pulleys is of fundamental importance not only to the belt but to the bearings that carry it. Improper tensions should be promptly re-adjusted to the least that will satisfactorily transmit without slipping the full load required of the belt. The use of rosin, soap or even an overdose of good dressing is to be rigorously avoided. If a belt will not do the work required of it without such destructive encouragement, it should be replaced by one of the proper dimensions.

All electric motors, engine drives and the like where large belts are used should be so mounted that the centre to centre distances between the shafts can be adjusted to give the proper tension to the belts, or in cases where this cannot be done, an idler pulley should be hung and weighted so that the most suitable belt tension will be constantly maintained.

The labor involved in caring for belts cannot reasonably be placed in the "unproductive" class any more than the capital invested in the belts themselves, for the one is vital to the efficient working of the other. The condition of a belt hanging down and the machine operative waiting for the belt man to turn up is one that could not exist with a properly regulated belt department. This saving alone coupled with the prevention of the loss due to slipping belts, to say nothing of the saving in capital investment, would make it a profitable matter to pay the belt man a very good salary.

* * *

Chatham No. 21, C.A.S.E., held their second open meeting for the season on March 19. The various members of the educational committee took up in turn the particular section of the work relative to stationary steam engineering on which they have been giving instruction to the members during the winter. Phonograph selections were interspersed with the foregoing, as also an address by Bro. Chas. Kelly on the work of the Canadian Association of Stationary Engineers. The annual banquet of the lodge was held on April 2, at which a full representation of the members and their wives was present. Following the usual loyal, patriotic and association toasts and a musical programme, dancing was participated in until a seasonable hour.

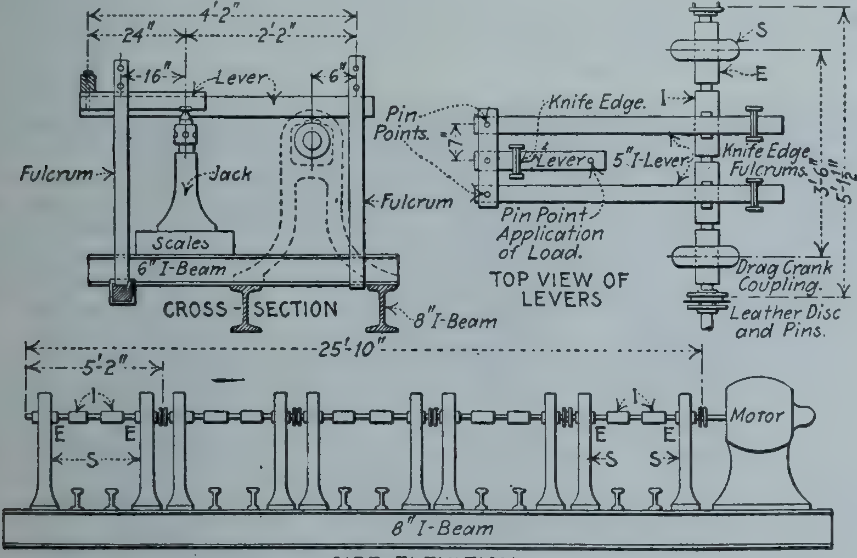
Comparative Tests of Three Types of Line Shaft Bearings

By C. C. Thomas, E. R. Maurer and L. E. A. Kelso.[*]

This paper, read before the A.S.M.E. and published here in abstract, covers experiments made to determine the absolute and relative amounts of power required to drive a series of uniformly loaded and flexibly connected shafts supported successively by three different types of bearings.

THE tests from which the accompanying data is derived extended over a period of four years, and were finally repeated and all results checked by a set of skilled observers, who had formerly no connection with the work. Twenty ring-oiled babbitt bearings supported successively a series of uniformly loaded and flexibly connected shafts, a wide range of loads and speeds being covered and co-officients of friction worked out for each type.

The apparatus was designed and built in the department of steam and gas engineering at the University of Wisconsin, in collaboration with the manufacturers of the bearings, and was so arranged that very exact measurements of power were attainable. All questions of possible lack of alignment, non-uniformity of loading, temperature and quality of lubricant, etc., were given careful study, resulting in the special form of apparatus used.



APPARATUS FOR TESTING LINE SHAFT BEARINGS.

Description of Apparatus.

The apparatus consisted of 25 ft. 10 ins. of line shafting in five equal sections, mounted in hangers (S), which were inverted and used as floor stands, Fig. 1. The hangers were bolted to two 8-in. I-beams. The shafts were of cold rolled steel, 2 7/16 in. in diameter, each section being 5 ft. 2 ins. long. The adjacent sections were coupled together by means of a flexible leather disk or two straps connecting the two flange couplings. The flexible couplings prevented the transmission of any part of the load applied on one shaft to either adjoining section, and also prevented binding between shafts and bearings due to possible lack of alignment.

A direct-current Fort Wayne motor was directly connected to one end of the shafting by means of a flexible coupling. The motor was of the interpole type with the interpoles removed, making it a shunt motor. A water rheostat was used in the field circuit to maintain a constant field, and another water rheostat was used in the armature circuit to vary the speed by varying the impressed voltage. The lost power was obtained first by taking the armature resistance for various currents and plotting a resistance, armature-current curve. From this curve was plotted an armature-I^2R loss, armature-current curve. From this the armature resistance loss for any armature current was obtained. The stray-power loss was obtained by taking a stray-power loss field current curve for each speed; then for any speed the loss for that speed and field could be obtained. By use of this method, the power required to run the motor alone at all speeds, without load, was accurately ascertained, as well as the power required to run the motor and shafts together, at all loads and speeds. The relative amounts of power required to overcome the friction of the various types of bearings were, therefore, accurately determined.

Application of Load.

The load was applied through levers upon hardened knife edges and pin points as fulcrums. Across the top of the 8-in. I-beams and at right angles to them were bolted short 6-in. I-beams to which the fulcrums were attached. The loads were applied to the shaft by two bearings between each pair of hangers. These bearings were identical with those in the hangers, and were supplied with knife edges which engaged a V-shaped groove in the 5-in. I-beam levers. The bearings and hangers for each section were symmetrically placed with respect to the middle of the section; therefore, equal loads on the intermediate bearings (I) produced equal pressures on the end bearings (E). These latter pressures exceeded those on the intermediate bearings by one-half the weight of the shaft, or by 40 lb. This difference is regarded as negligible in the paper, and load per bearing means average of the loads on intermediate and end bearings. The bearings were prevented from turning by short levers fastened to them and resting upon uprights from the floor. Only one type of bearing was tested at a time, so that no complications might arise in establishing the losses for the particular form under test. The reason for using 20 bearings was that the amount of power necessary for a single bearing was so small as to be difficult of exact measurement. Also any single bearing might not as truly represent results from that type of bearing in general as several bearings taken together.

The Bearings Feature.

The three kinds of bearings tested were:—The ring-oiled bearing, manufactured by The Dodge Mfg. Co., lined with babbitt metal made from their formulae; the Hyatt roller bearing, manufactured by the Hyatt Roller Bearing Co.; and the Hess-Bright ball bearing, manufactured by the Hess-Bright Mfg. Co. All bearings were for the same size shaft, and, in fact, the same pieces of shafting were used for all the tests, except that two sections which bent during the tests were replaced.

---

[*] Professor of Mechanical Engineering, Johns Hopkins University; Professor of Mechanics, University of Wisconsin, and Instructor in Electrical Engineering, University of Wisconsin, respectively.

The babbitt bearings were 9 21/32 in. long, and hence their projected area was 22.36 sq. in. The following table is appended for converting total loads used in the tests into unit loads:—

730	1230	1730	2230 lb. per bearing
33	55	78	100 lb. per sq. in.

These bearings were oiled by the well-known ring-oiler device, two rings in each bearing.

Each roller bearing contained six right-hand and six left-hand rollers, .78 ins. in diameter; six being 9 9/16 ins. long, and six being 9 3/16 ins. long. They were of the type in which a cage is used for holding one-half the rollers. Each ball bearing contained a single set of balls, 9/16 ins. in diameter, while the diameter of the inner race through the ball groove was 3.4729 inches. The power was measured by the ammeter voltmeter method, while mercury thermometers (two in each babbitt and roller bearings and one in each ball bearing) were used for measuring the temperature of the oil or bearing.

The speeds used in the tests were between 150 and 450 r.p.m., corresponding respectively to about 100 and 300 ft. per minute peripheral speed. Most of the loads used were between 700 and 1800 lb. per bearing, corresponding respectively to about 30 and 80 lb. per sq. in. for babbitt bearings. All statements of results, therefore, are subject to the above limitations as to speed and loads.

Two lubricants were used in all the tests—Atlantic red engine oil in the babbitt and roller bearings, and No. 2 Keystone grease in the ball bearings.

Results of Tests.

For all conditions of load and speed the power decreased with increase of temperature, but the rate of decrease at the highest load and speed was more marked in the case of the babbitt bearings. At the lower speeds the power did not vary at all with the temperature, practically speaking.

Table 1.—Relative Amounts of Power Consumed in Friction.

	100 Ft. Per Min.		300 Ft. Per Min.	
Bearings.	77 Deg.	100 Deg.	77 Deg.	100 Deg.
Ball	1	1	1	1
Roller	2.2	2.5	2.7	3
Babbitt	3	3.6	4.5	4

In a comparison of the babbitt, roller and ball bearings for 100 degs. and 77 degs. temperature, it was shown that the power for the babbitt is higher than for the other bearings except perhaps at low loads and speed, and that the power for rollers is higher than for balls. The excess of power for babbitt over rollers and rollers over balls increases with increase of speed for all loads. Table 1 shows the relative amounts of power consumed in friction by the three kinds of bearings at the speeds and temperatures indicated. The relative numbers are based in each case on the average power for three loads: 710, 1210, and 1710 lb. for balls; 740, 1240, and 1740 for rollers; and 730, 1230 and 1730 for babbitt.

Breakdown Tests.

In order to observe the performance of the bearings under extraordinarily heavy loads, breakdown tests were run on each type of bearing with only one section of shafting, on which were four bearings. This small number of bearings was used because it was impracticable to keep close watch of a larger number of bearings and avoid trouble during the excessively severe conditions. The maximum load was 600 lb. on the scales, or about 5000 lb. per bearing.

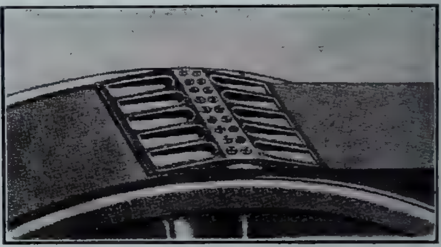
The speed of 200 r.p.m. was chosen because it represents about the average lineshaft speed in practice. These tests began at about 3200 lb. per bearing. Failure occurred at about 4250 lb. per bearing in the case of the babbitt, 4650 lb. in the case of the ball bearings, and about 5100 lb. in the case of the roller bearings. The quality and amount of lubricant used undoubtedly have an important effect upon the load that will cause a given bearing to fail.

The bearings did not in any case "fail" structurally, as the power was cut off soon after distress was manifested, but the failure was simply that of the lubricant. Breaking down of the lubricant results in an immediate increase of the power required to maintain the original speed of rotation of the shaft in the bearings. In each case probably only one of the four bearings used in the breakdown tests showed distress at any one time. In the case of ball bearings, this was evident, as distress was manifested by disintegration of the grease which "melted" and ran out of the bearing. This was accompanied by an immediate increase in power requirement. The temperatures given (99 deg.-117 deg., etc.) indicate the averages for the four bearings being tested. Similar behavior on the part of the babbitt and the roller bearings indicated that at least one of the four under test was suffering from an approach to "metal-to-metal" contact. The bearings were not injured by these endurance tests, and all were used in subsequent tests at the more usual speeds and pressures.

STEEL DRIVING BELTS.

WHILE engineers generally have been devoting a good deal of attention to improvements in chain and tooth gearing for transmitting power, says The Engineer, a new system of belt-driving has been introduced in Germany which appears to possess many advantages over some of its older rivals. We refer to transmission by means of steel belts on the Eloesser system.

These belts are made from a specially-hardened carbon steel having a very high tensile strength. The belts vary in thickness, and are made in widths between 1½ in. and 8 in. The tension required is determined with very minute accuracy by a special instrument, and only one flexible steel joint is used. The belts run on flat pulleys, which are covered with a composite layer of canvas and cork. They are only about one-sixth of the weight of leather belts or ropes suitable for transmitting similar powers, and there seems to be no practical limit to the speed at which they can be run.



JOINT FOR STEEL BELT.

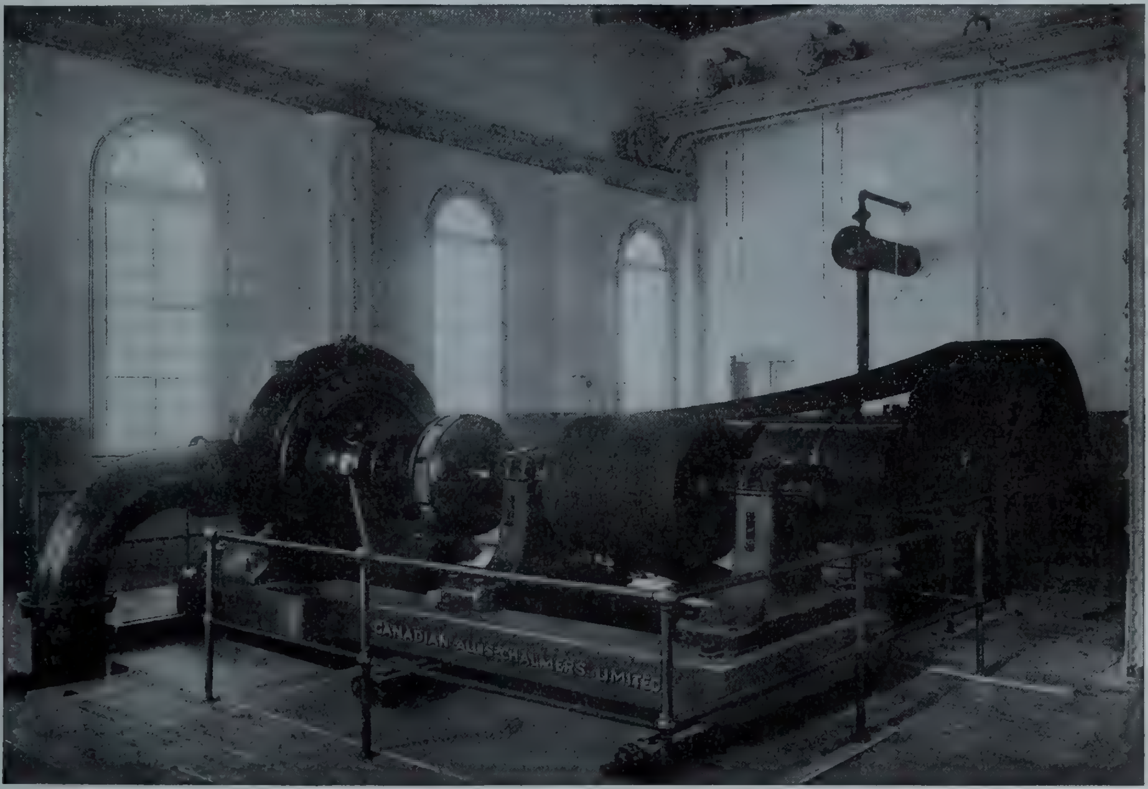
So far, it has not been found feasible to use these belts with fast and loose pulleys, although they are suitable for employment with friction clutches. Neither is their adoption recommended for cross-belt work where the distance between the centres of the pulleys is less than eighty times the width of the belt, nor for very small pulleys, on account of the bending stresses set up. For continuous drives, however, no matter how close or distant the centres, and either horizontal or vertical, the steel belt has been applied with remarkably efficient results. It is claimed that a steel belt is only about one-third the width of a leather belt for corresponding power, that it does not stretch even with years of work, and, as there is no measurable slip, the transmission is uniform and invariable.

In order to convert pulleys from rope driving to steel belt transmission, a stout steel band is strained round the pulley rim and fastened to a plate fitted into a small cut-out section of the pulley grooves. The smooth surface thus formed is serrated and provided with a friction covering of the kind referred to above. The method of jointing consists of a special clamp mounted on the ends of the belt, and after the required tension has been applied, the ends are threaded between an upper and lower steel plate shaped to suit the pulley profile until they abut. The clamping plates are then closed by a number of countersunk screws, and soft solder is run into the joint to prevent the screws from slackening. The edges of the belt are rounded off, so that it can be safely handled while running.

The belt is being introduced into Great Britain by the Power Pulley Co., Ltd., Union Works, Manchester, which has already fitted up several large cotton mill drives in the Manchester district on the system with excellent results.

ROPE DRIVE—GAS ENGINE AND BOOSTER PUMP.

THERE has recently been installed at the municipal pumping station, Moncton, N.B., a gas engine driven booster pump. An interesting feature of same being the rope drive which may be noted in the accompanying illustration. The entire equipment was supplied and installed by Canadian Allis-Chalmers, Ltd., Toronto, under the supervision of Mr. John Edington, city engineer of Moncton.



MUNICIPAL PUMPING PLANT, MONCTON, N.B.

The plant includes a two stage turbine pump capable of delivering 3,470 Imperial gallons per minute against 300 ft. head when operating at 750 r.p.m. The pump is mounted complete, with flexible coupling and two pedestal bearings with rope pulley between, on a cast iron base-plate which is provided with slide rails. The slide rails are used to facilitate the adjustment of the driving ropes.

The pump is driven by a rope drive of the multiple or English type, and consists of twenty-six 1 in. cotton ropes. This type of drive was chosen because of its high efficiency and low initial cost. The appearance of the set of ropes as seen in the cut is almost identical with that of a belt, which demonstrates the uniformity of rope tension attained.

The motive power is a "Premier" gas engine ofthe latest four-cylinder side by side Otto type. It is capable of delivering 460 B.h.p. when running at 200 r.p.m., and operating on natural gas. A special speed regulator is provided in the engine so that the speed may be changed instantly from 160 r.p.m. to 200 r.p.m. The water pressure at the pump delivery may, therefore, be changed from "domestic to fire" pressure as required, these pressures being 45 and 110 pounds respectively.

The fuel for the engine is natural gas which is piped to the plant from a local gas-field. An emergency source of supply is however, provided, in the shape of a suction gas producer for operation on pea anthracite. Auxiliary apparatus for "blowing-in" the producer and for supplying compressed air for starting the gas engine is provided.

LOCATING CAUSE OF PRE-MATURE IGNITION.

By R. Bell.

A 300 h.p. 4-cylinder vertical gas engine, after being erected and put into service, was found to pre-ignite very badly in one cylinder. This took place only under heavy load, and when the producer gas used was fairly rich. The line of demarcation between conditions which insured successful operation and those causing heavy pre-ignition seemed to be very finely drawn and the source of the trouble was therefore very hard to locate. The diameter of the cylinders was 14 inches, and it was considered just possible that the centre of the piston in the cylinder that gave the trouble was becoming overheated. The exhaust valve head was also looked upon with some suspicion.

It was finally decided to drill a ⅜-inch tapping hole in the exhaust valve and plug it with aluminum. This done, the engine was started up and run until pre-ignition began. The exhaust valve was now examined and the aluminum was found to have been melted out. This showed that the temperature attained by the valve must have been at least a low red heat. All the exhaust valves were replaced with water-cooled valves and no further trouble was experienced.

It seemed that the critical stage had been reached with this size of engine as engines with 16-inch cylinders gave no trouble whatever.

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INSTRUCTION COURSE FOR OPERATORS.

BEGINNING with the May issue and continuing each month thereafter, an Instruction Course for firemen and engineer operators will form a feature of The Power House. The subject discussed in each number will be dealt with in such manner as to make it complete in itself in addition to being relative to the whole, and all interested or engaged in the practice of stationary steam engineering, and who are desirous of not only being well grounded in the elementals, but are anxious to keep posted on and appreciate new developments, now so far-reaching and revolutionary, are invited both to study and appropriate the instruction given, and preserve each section for future reference.

The author of this Instruction Course has had a long experience in the practical work of this highly important accessory of commercial and industrial enterprise, as well as in the art of teaching, whereby others may easily become interested and consequently informed to their profit, and we feel sure that right from the start, to express our own opinions somewhat modestly, all sections of our readers will be gratified and much benefited. The following is a brief synopsis of the course:—

Steam Engines—History, Principles, Construction, Valve Theory, Valve Setting, Steam Engine Cycle, etc.

The Bilgram, Indicator, Indicator Diagrams, etc.

Compound Engines, Condensers, Valve Gears.

Steam Boilers, Boiler Furnaces, Theory of Combustion, Smokeless Combustion, Boiler Operation.

Boiler Accessories—Pumps, Injectors, Feed Water Appliances, Exhaust Steam Heating.

Steam Turbines, Gas Engines, High-Speed Engines.

Refrigeration, Transmission, Switchboards, etc.

* * *

ENGINEERS' EXAMINATIONS.

IT is more or less surprising to note the different standards of technical and general education required by engineers' examining boards in different parts of this country. The requirements are perhaps the most stringent and thorough in the Province of British Columbia where a graded system is employed. The standards of other provinces dwindle more or less in comparison, until in some, the securing of an engineer's license is more or less a matter of form, and the appointment of examiners is left largely to political patronage.

The graded system, which makes time of service, breadth of experience and technical ability requisite steps in the ladder of advancement has much to recommend it. By means of it the employer is more likely than otherwise to secure an engineer of the necessary ability for his plant, besides being in a better position to determine meritorious promotions. The engineer has always before him the opportunity of obtaining for himself an acknowledged higher standing as an organizer and mechanic and thus making himself eligible for a higher position.

Our universities set standards at their head offices which regulate examinations for the whole Dominion, and a degree from one of them represents the same educational worth wherever it be found or by whom it be possessed. Many classes of artisans, as is the case with plumbers, etc., regulate not only the standard of remuneration, but have suceeded in securing a common standard of sanitation wherever their organizations are active, and the question of degrees of engineers' fitness is, we think, also a matter for the engineers' societies, backed up by Federal authority, to decide.

It is a significant fact that British Columbia, where the standard is comparatively high and coupled with a system of machinery inspection, has one of the most enviable records for security from machinery accidents on this continent.

ASSOCIATION AND PERSONAL

A Monthly Record of Current Association News and of Individuals Who Have Been More or Less Prominent in the Power Field.

F. W. Moore has been appointed manager of the Garlock Packing Co., Montreal branch.

W. A. Owen has been appointed city engineer of Nanaimo, B.C. The new official has been a resident of Nanaimo for some time.

Ward Curlee has been appointed city engineer of Swift Current, Sask., to succeed Geo. D. Mackie, who resigned recently. Mr. Curlee has been assistant city engineer for some time.

David Webster, chief engineer of the Brantford, Ont., waterworks, was presented by the Board of Works Commissioners, with a gold watch suitably inscribed, in recognition of his 25 years of service with the city. He was previously for 12 years with a private company which owned the plant prior to civic ownership.

R. Percy Sims, chief engineer and general manager in Canada for the Linde British Refrigeration Co., Ltd., is severing his connection with the company on May 1st, next, in order to devote his whole time to consulting work. his headquarters will be in Montreal. The Linde British Refrigeration Co. have consequently decided to close their Canadian office, as the profits of the branch have not been commensurate with those earned in other parts of the world. During the past three years the company have obtained a large number of orders from all over the Dominion; but, generally speaking, the returns obtained have been inadequate.

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D. K. McLAREN DEAD.

DAVID KEAY McLAREN, president of D. K. McLaren, Ltd., Montreal, the well-known makers of high grade leather belting, died at Montreal on March 18th, after a long illness. The deceased was born in Perth, Scotland, on February 20, 1835, and was thus in his eightieth year.

Mr. McLaren had an active career and was one of Montreal's pioneer business men. He came to Canada in May, 1852, and went later to Southern Vermont, where he engaged in the boot and shoe business. In 1864, however, he returned to Montreal where he continued to reside up to the time of his death. For a great many years he was associated with other members of his family in the leather belting trade, and finally in the year 1896 set up in business for himself. In 1907 his business was incorporated as D. K. McLaren, Ltd., with the deceased gentleman as president, which position he held up to the day of his death. He had not taken an active part in the business, however, of late years owing to failing health. The firm's interests have been and still are being looked after by his two sons, W. Fred McLaren and R. M. Walker McLaren.

THE LATE D. K. McLAREN.

The late Mr. McLaren was an active member and supporter of the First Baptist Church and the Y.M.C.A. in Montreal. He is survived by a widow, two daughters, the two sons mentioned above, and by one brother, W. C. McLaren, of Guelph, Ont.

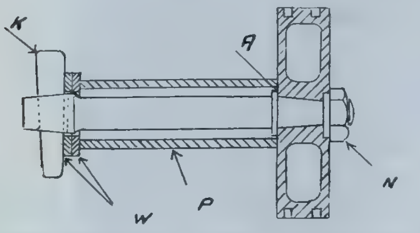
THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

REMOVING LOCOMOTIVE PISTON RODS FROM HEADS.

By R. Bell.

THE sketch is descriptive of a good method of removing piston rods from heads. These, when put on, are generally fitted up on the taper to within an ⅛ in. of the shoulder (A). The piston is then heated and the rod put in and drawn up to the shoulder by the nut (N). This makes a tight fit, and it is difficult to remove the rod again when necessary. By the method shown, a very tight piston can easily be removed. (P) is a piece of pipe of sufficient diameter to slip over the rod, and of convenient length, as shown, to come within two inches or so of the crosshead key slot. The distance between the end of the pipe and the slot can be made up with washers (W) (W) of suitable thickness, which afford a better surface for the key (K) than would the edge of the pipe. Their use also allows for a little variation in the distance between the piston head and the key slot in different rods. The washers must overlap the inner edge of the key slot so that the key will have a little draw. (K) is a tapered steel key. The pipe and washers are put on, as shown, and the key driven in with a sledge hammer. This method is much quicker and easier than heating the head when a rod has to be removed.



REMOVING LOCO PISTON RODS FROM HEADS.

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FLYWHEEL QUERY SOLUTION.

By N. G. Near.

CONCERNING H. Westwood's query in the February issue of **The Power House**, there is not sufficient information given to arrive at a very exact or even satisfactory solution. Much depends upon the design of the flywheel—number and type of arms, manner of casting, bolting, etc.

Bearing "average" conditions in mind, however, I would say that there is practically no change in tension on the hub bolts. There should be none, for the same reason that there should be no change in tension in cylinder cover studs, which has recently been so thoroughly discussed in **The Power House**. Most of the stress, in flywheels, caused by centrifugal force, must be borne by the rim bolts; it having been shown, for example, that in some designs there is absolutely no change in stress in the flywheel arms save that due to the centrifugal force of the arm itself. Of course, there are bending stresses set up, caused by acceleration and deceleration, but these will be neglected here. We will consider centrifugal force stresses only.

Applying the old flywheel formula

$$P = \frac{12\,W\,V^2}{G}$$

where (P) is the tensile stress per sq. in. in the flywheel rim, (W) the weight of one cubic inch of the material of which the flywheel is made (0.26 lb for cast iron), V the velocity of the flywheel rim in ft. per sec., and G = 32.16 the acceleration due to gravity, we get, for Mr. Westwood's wheel 785 lb. per sq. in.

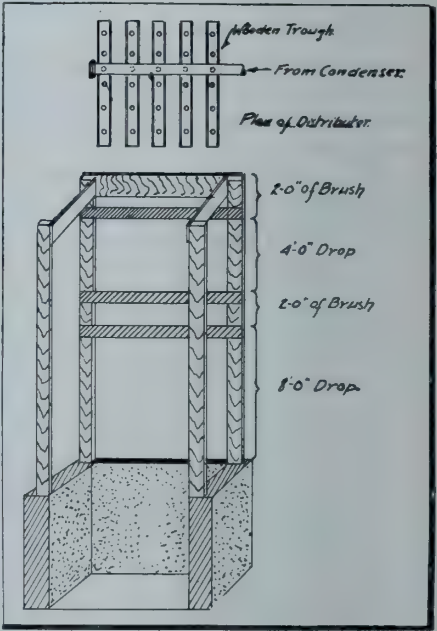
Assuming a ton to be 2,000 lbs. and, solving for the cross-sectional area of the rim, I get an area of 170 square inches. The total tension is therefore 785 lb. per sq. in. × 170 = 133, 600 pounds; the same to be held by two bolts or about 70,000 lb. per bolt, which is a whole lot more than should be allowed, inasmuch as the cross sectional area of each bolt is only about 3 sq. in., the unit stress thus being 23,000 lb. per sq. in.

I therefore contend that if Mr. Westwood's flywheel is an average design, the stress in the hub bolts will not change, whereas the stress in the rim bolts will increase about 69,000 pounds.

HOME MADE COOLING TOWER.

By Chas. Fenwick.

AMONG the attachments and accessories to a condensing engine, the cooling tower is often expensive and always more or less bulky and cumbersome. These and some other objections to the condensing engine, particularly for temporary installations have been overcome by one engineer in a very satisfactory manner. The accompanying sketch shows an improvised cooling tower consisting of a wood framework with a tank at the bottom to serve as a reservoir for the cooled water. The water from the condenser is distributed over a two-foot layer of brush or edgings by means of perforated wooden troughs as shown. From this it drops through a space of 4 feet to a second and similar layer and thence eight feet to the tank.



HOME-MADE COOLING TOWER.

The above tower has handled satisfactorily the cooling water from a jet condenser attached to a 13 in. × 30 in. Corliss engine working steadily under full load and at 20 per cent. over load for short periods. When it is desired to move the plant as in the case of portable lumber mills, etc., the water cooling apparatus can simply be discarded and a new one built.

◆

HORSE-POWER OF "ATLAS" ENGINE.

By H. W. Benton.

FRANK BAKER, Winnipeg, can very easily figure the horse-power of his Atlas engine by using the constant 4.127, thus:

Horse-power = 4.127 × M. E. P.

This constant is obtained by multiplying together the piston speed in feet per minute and the area of piston in square inches, and dividing the product by 33000, thus:

$$\frac{L\ A\ N}{33000}=\frac{\frac{16}{12}\times 268.8\times(190\times 2)}{33000}=4.127$$

It should be quite clear to all that there are three items entering into the calculaton of engine horse-power that are not variable or alterable; namely, length of engine stroke, area of piston, and horse-power standard (33000 ft. lbs.).

Now, if we have a constant speed engine we can also add that item to the list, thus: r.p.m., and there is now only one item left out, and that is the one which is always changing; namely, the m.e.p., or mean effective pressure, and all types of engine governors regulate the speed of the engine by changing this one item of the h.p. calculation. Every variation of load and of boiler pressure bring about a corresponding change in the position of the governor, and thus the m.e.p. is altered so as to just equal the power required. All Bro. Baker has to do now is to decide for himself what the m.e.p. is, and then multiply. If his full load m.e.p. be 56, then horse-power = 4.127 × 56 = 231.112, and if his friction load m.e.p. = 16, then friction load horse-power = 4.127 × 16 = 66.032. The m.e.p. can either be taken from indicator diagrams or by computing from the boiler pressure, due to point of cut-off. The procedure for this latter is, I think, too well known to need explanation here.

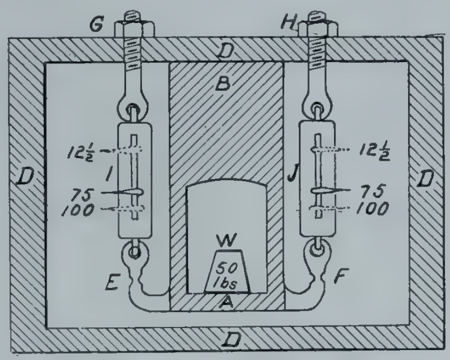
◆

TENSION ON CYLINDER COVER STUDS.

By J. G. Smith.

I HAVE read with interest the debate on "Tension on Cylinder Cover Studs," and would be pleased to see such educational discussions come up oftener in your valuable journal. I give the following as my explanation and will be much gratified if you can find space to publish it.

Referring to the sketch (AB) is a tray, containing an aperture to hold the weight (W), and arranged to press against frame (D). Supporting arms (E) and (F) are so reduced that they will break under a load of 100 pounds. These connect to the frame (D) (D) through the spring balances and bolts as shown. The weight of the tray without the weight (W) is 25 pounds. Now, if the nuts (G) and (H) be screwed up until the pointers on the spring balances register 75 pounds each, the tray (B) will be forced against the frame (D) with a pressure of 75—12½=62½×2 or 125 pounds. Upon adding the weight (W), the indications on each scale will be 12½+6½+25=100 pounds, which is the breaking load of (E) and (F).



TENSION ON CYLINDER COVER STUDS.

Supposing the pointer to have moved through a distance of 2½ inches when registering 75 pounds, the addition of the extra weight (W) will have caused (B) to recede from (D) one inch before the members (E) and (F) fail. This imaginary experiment proves to my mind that the theory advanced by Mr. Rogers is correct; that is, when steam or any other pressure is applied to a cylinder head, an immediate stress is put on the studs that support it.

◆

REPLY TO VALVE SETTING QUERY.

By H. W. Benton.

WITH regard to "Valve Setting" information required by R. W., Ottawa, it may be said that all types, styles, designs, etc., of valves and valve gears for steam engines perform the same duties; viz., admit the steam into the cylinder, cut off the steam supply so that no more can get in for the balance of that stroke, open the exhaust port so as to allow the steam to escape, and close the exhaust so as to trap a part of the exhaust for compression purposes, so that the clearance space may be partly built up in pressure by the time the live steam is again admitted for the next power stroke. These events occur as above in each end of the cylinder of a double-acting steam engine. In some types of engines these four points or events of steam distribution in each end of the cylinder are positive; that is, they take place at the same relative part of the piston stroke at all times, regardless of load, speed, or variations of boiler pressure. Such engines are regulated by throttling governors. Automatic engines do not employ any throttling device for regulation, these being regulated by varying the point of cut-off so that the quantity of steam admitted to the cylinder varies with the load and fluctuations of boiler pressure.

The simple Corliss engine is one of this class. The points of the steam distribution are positive; viz., admission, release and compression, the cut-off only being variable according to the action of the governor.

The buckeye engine, although of different construction from a Corliss engine, has exactly the same feature of regulation, the point of cut-off being the only variable.

Again, we have the Skinner engine and the Robb-Armstrong engines. These have variable cut-off and compression, and, in fact, are variable in all particulars, but the variation of admission and release is small compared with that of the cut-off and compression. These latter are controlled by the action of the governor.

The foregoing are a few pointers on valve setting in general, and although valve setting is considered by some to be a very intricate job, there is really no difficulty experienced in accurately adjusting the valves and valve gear of any type of engine after one gets thoroughly to understand the few main points.

All steam engines properly adjusted admit live steam into the cylinder while the piston is passing the dead centre; cut off the supply of the steam to the cylinder some time during the stroke of the piston, according to the type of engine, the load and the boiler pressure; release the steam from the cylinder just before the piston reaches the end of the stroke, so that the piston returns on the exhaust stroke with as little back pressure as possible; close the exhaust port just before the piston reaches the end of the exhaust stroke, so as to compress a part of the exhaust steam, thus filling the clearance space with steam at a pressure of about one-third of the boiler pressure, by the time the steam valve opens to admit live steam into the cylinder again, to repeat these four events again.

In the next issue will appear a general valve-setting article, with plain explanation of how to set the valves of some of our most popular engines.

GAS ENGINE TROUBLES.

H. Westwood.

IN the March issue of "The Power House,' on page 87, there appeared an article entitled "Gas Engine Troubles," by W. M. Grey. While I do not pretend to be an expert on this subject, I have had a fair amount of success with this kind of apparatus, and will endeavor to give my views on the cause of his troubles. The information regarding the plant being very vague, I shall have to draw my own conclusions.

There are many reasons for the engines acting as they do. One thing it is difficult to find the causes of trouble in a gas plant, because so many different things can produce the same conditions. Try only one likely cause at a time, and note the results. Don't do a half dozen things to eradicate the trouble, and having accomplished it, not know which was responsible.

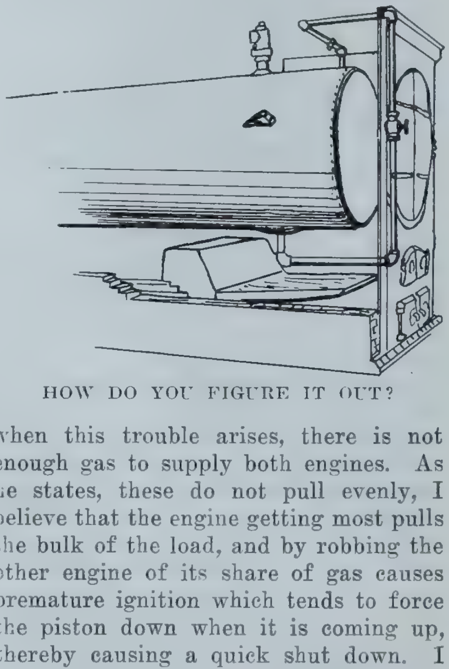
Mr. Grey states that a shortage of oil in the crank case will produce pounding. Regarding this problem of oiling, I wrote an article in the November, 1913, issue of "The Power House," on splash lubrication, which I think may be of value. I would, however, have had a better idea how to answer the query if I had known the horse-power of the engines, and the kilowatt capacity of the generators.

I do not believe that the trouble is with the electrical equipment. When two or more dynamos of different outputs, size, or make are running in parallel together, it frequently happens that all the characteristics are not exactly similar and, therefore, the load is unequally distributed, some being overloaded, while others do not take up their proper share of the work. If the difference be small, it may be compensated by means of the hand regulator, but if large, other means must be taken to cause the machines to take up their proportion of the load. If the series coils of the several dynamos are provided with small adjustable resistances in the form of German silver or copper ribbon inserted in series with the coils, the distribution of the current in the latter may be altered by varying the resistance attached to the individual coils, and thus the effect of the series coils upon the individual armatures in raising the pressure may be adjusted, and the load thus evenly divided among the machines.

If one generator were trying to motor the other it would soon become apparent by its disastrous effect, providing the circuit breaker is not equipped with a no-voltage release. Again, if the one engine were trying to pull the combined load of both machines and the other engine against full compression, it would stop the other one also. It is not stated whether the engines run with natural or producer gas of the suction or pressure system. Either one of these methods of supplying gas has its own peculiarity of making the engines behave as indicated. As either of them will close down at intervals, it is not very likely to be the fault of the magnets. My experience tells me that the trouble is with the gas.

Pounding may be due to the following causes, viz.:—Badly worn or broken piston rings, improper valve seating, a badly worn cylinder or piston, loose wrist pin in the piston, a loose journal cap, or fly wheel loose on the shaft, but none of these will stop your engine. A pound produced by any ofthe above causes is constant and will continue as long as the engine is running, but a pound caused by premature ignition may be described as a dull heavy thud which almost makes your hair stand straight. This premature ignition can be caused by three things:—poor lubricating oil, ignition too far advanced, or too weak or rich a mixture.

Mr. Grey states that he has experienced this trouble just lately. Taking it for granted that this has not always been the case, I believe he will find that when this trouble arises, there is not enough gas to supply both engines. As he states, these do not pull evenly, I believe that the engine getting most pulls the bulk of the load, and by robbing the other engine of its share of gas causes premature ignition which tends to force the piston down when it is coming up, thereby causing a quick shut down. I would advise him to pay particular attention to the suction indicators on the gas pipe or the various ones on the producer scrubber, etc., if he has one, and note the height of the suction. In a well designed plant the suction should not rise more than from three to five inches. Note also if this shut-down does not take place when the suction is high.



HOW DO YOU FIGURE IT OUT?

HOW DO YOU FIGURE IT OUT?

By Robt. McLaren.

RECENTLY on visiting a steam plant I noticed a pipe leading from the top of the boiler down the side and through the setting into the furnace. In the pipe was a valve, which the engineer occasionally opened. Curiosity led me, while the engineer was temporarily absent from the boiler-room, to open the furnace door to investigate. On the bottom of the boiler shell over the fire was a large bulge, into which the pipe was tapped.

Upon the engineer's return he opened the valve as usual and closed it. Here was an opportunity to obtain some untaxable data, so I asked him the purpose of the pipe. He said there was a "bag" on the bottom of the boiler, and that scale and mud had a tendency to settle there; so he ran a pipe from the steam space to the centre of the bulged plate, and, by opening the valve occasionally, he allowed steam to create such a disturbance that the undesirable material was driven out of the "bag" and overheating of the plate was prevented. Incidentally he remarked that the ability to achieve a desired end was more important than passing examinations for certificates.

◆

REPLY TO BOILER HORSE-POWER QUERY.

By H. W. Benton.

THE horse-power of a boiler, that is to speak strictly of boiler horse-power and not the power that can be developed by an engine from a boiler of given size, is the quantity of water that can be evaporated per hour from feed-water of a certain temperature into steam at a certain pressure.

The difference in the horse-power of a boiler at 100 lbs. per sq. in. and at 125 lbs. per sq. in. pressure is not worth consideration, so far as the boiler itself is concerned, in so far as the difference between the quantities of water it would evaporate into steam under the two different pressures from a given quantity of coal in a given time is concerned, it being so small as to be neglected.

The standard or boiler horse-power is the evaporation of 34.5 pounds of water at 212° F. into steam at the same temperature and at atmospheric pressure per hour, or its equivalent. Actual operating conditions in any plant are compared with this standard by the use of the table of factors of evaporation. Example:—

Steam pressure of 120 lbs. gauge.

Feed-water temperature at 140° F.

Quantity of feed-water per hour, say, 16100 lbs.

Factor of evaporation = 1.119.

$$\text{H.P.} = \frac{16100 \times 1.119}{34.5} = 522.2$$

In the table of factors of evaporation, the difference between 100 lbs. and 125 lbs. is only $\frac{3}{1000}$, so that the horse-power would be practically the same under both pressures.

Arithmetic for the Machinist and Workshop Operative

By J. H. Rodgers

Doubtless some of the elementary work in the first few articles of this series may appear more or less superfluous, but it must be remembered that numerous simple rules and formulae appear from time to time in Technical Journals, which are discarded and dubbed impractical by many operators for the simple reason that the elementals are either unknown or have been forgotten. The purpose of this course will have been achieved if the above tendency is even in part combatted.

INVOLUTION and evolution were explained, and the procedure to be followed in the extraction of the square root of a number was detailed in the concluding section of the lesson in our March 5 issue. In the present instance, extraction of the cube root of a number, and ratio and proportion are the features dealt with.

Cube Root.

The cube root of a number is found in this manner: Suppose we wish to cast an iron sphere which will weigh 266 lbs., what must be the diameter?

Assuming a cubic inch of iron to weigh .26 of a lb.; then 266÷.26=volume in cubic inches of the sphere=1023.077 cu. in.

To find diameter, use the formula Volume=.5236 d³, or

$$d^3 = \frac{\text{Vol.}}{.5236} = \frac{1023.077}{.5236} = 1953.928.$$

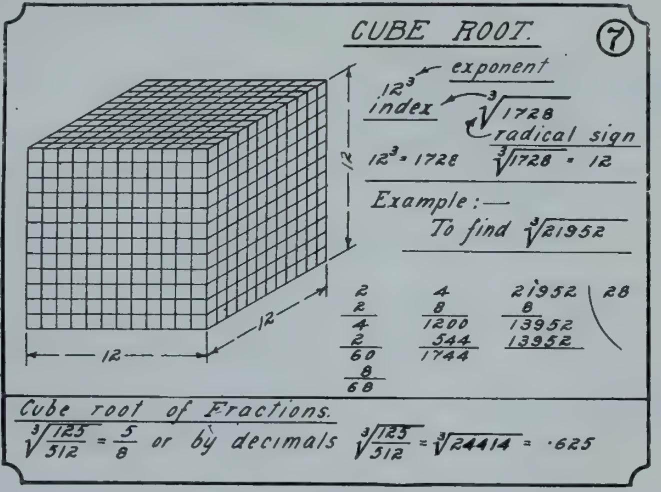
Then $d = \sqrt[3]{1953.928}$.

Explanation.—Arrange the work in three columns, placing the number whose cube root is to be extracted in the third column. From the decimal point, separate the number into periods of three figures each. Find a number whose cube is less than the first period. Write this figure as the first figure of the root, also at the head of the first column.

One	Two	Three
1	1	1953.928(12.68
1	2	1
2	300	953
1	32	664
30	332	289.928
2	68	253.176
32	40000	36.752000
5	2196	35.784832
34	42196	967168
2	2232	
360	4442800	
6	30304	
366	4473104	
6		
372		
6		
3780		
.8		
3788		

Multiply the number in the first column by the first figure of the root, and write the result in the second column. Multiply the number in the second column by the first figure of the root, subtract the product from the first period, and annex the second period to the remainder for a new dividend. Add the first figure of the root to the number in the first column for the first correction; multiply the first correction by the first figure of the root, and add the product to the number in the second column. Add the first figure of the root to the first correction to form the second correction. Annex one cipher to the second correction, and two ciphers to the last number in the second column. This is the trial divisor.

Divide the dividend by the trial divisor, to find the second figure of the root; add this to the number in the first column, multiply the sum by the second figure of the root, and add the result to the trial divisor to form the complete divisor. Multiply the complete divisor by the second figure of the root, subtract the result from the dividend, third column, and annex next period to the remainder for a new dividend. Add the second figure of the root to the first column to form the first correction; multiply the first correction by second figure of the root, and add the product to the complete divisor. Add the second figure of the root to the first correction to form the second correction. Annex one cipher to the second correction, and two ciphers to the last number in the second column to form a new trial divisor. Continue in like manner to the last period.



ARITHMETIC CHART 7.

To extract the root of a fraction, extract the required root of the numerator and denominator separately; or change to a decimal, and extract the root of the decimal. (See Chart 7.)

Consistent study of this subject will prove of much benefit to those who have been hitherto unfamiliar with its application.

* * *

Boiler Explosion.—One of the large boilers in the Bankhead plant of the Drummond colliery, Westville, N.S., operated by the Intercolonial Coal Co., exploded on April 2, and Daniel McMillan and J. Ryan were killed and five others injured.

* * *

London No. 30, C.A.S.E., annual smoker, held in their lodge rooms on April 8, proved an interesting and pleasant function. President Middleton was in the chair. An excellent programme, consisting of musical numbers and speeches, cards, and the worship of "My Lady Nicotine," contributed to the pleasure of the evening. R. Irvine, L. Sage and J. Flaven were the instrumentalists, and W. G. Walters the vocalist in the realm of music, while Geo. Moll, R. Lyons and D. F. Campbell were responsible for some speechmaking of a highly humorous order.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent, practical questions, and give same direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

Question.—A vertical steel rod, 1½ inches in diameter, has a weight of 35,340 lbs. suspended from its lower end. What is the stress per square inch of cross-section of the rod?

Answer.—Find the area of the cross-section of the rod, and divide the load by this area. Thus:

$$\text{Area} = \frac{3.1416 \times 1.5 \times 1.5}{4} = 1.767 \text{ sq. in.}$$

$$\text{Stress} = \frac{35340}{1.767} = 20{,}000 \text{ lbs. per sq. in.}$$

* * *

Question.—A hoisting drum is three feet in diameter. How many revolutions will it make in winding up 100 feet of rope. The drum is to be considered as being wide enough to take all the rope in one layer—no overlapping.

Answer.—The drum in one revolution winds up

$3.1416 \times 3 = 9.4248$ ft. of rope,

therefore, to wind up 100 feet it must make

$$\frac{100}{9.4248} = 10.6 \text{ revolutions.}$$

* * *

Question.—A locomotive has driving wheels 66 inches in diameter. If the wheels slip 22 revolutions per mile, how many revolutions do they actually make in four minutes when running at thirty miles per hour?

Answer.—At 30 miles per hour, the distance covered in four minutes is:

$$\frac{30 \times 4}{60} = 2 \text{ miles.}$$

In two miles there are 10,560 feet, and the number of revolutions made by the 66-inch (5½ feet) wheels in this distance, including slippage, is

$$\frac{10560 \text{ ft.}}{3.1416 \times 5.5 \text{ ft.}} + (2 \times 22 \text{ revs.}) = 655.18$$

revolutions.

* * *

Question.—A railroad car wheel, 42 inches in diameter, is found to be three pounds out of balance at a radius of 18 inches. What will be the "hammer blow" on the rail at every revolution when running at 30 miles per hour?

Answer.—There are 5,280 feet in one mile, and the number of revolutions made in one mile by a 42-inch (3½-feet) wheel is

$$\frac{5280}{3.1416 \times 3.5} = 480 \text{ rev. per mile.}$$

The car travels one mile in two minutes, and therefore the revolutions in one second are

$$\frac{480}{2 \times 60} = 4 \text{ revs. per second.}$$

The hammer blow on the rail will be the centrifugal force of the unbalanced weight, and this centrifugal force (F) is expressed by the formula:

$$F = \frac{Wv^2}{gR}, \text{ where}$$

F=the centrifugal force in lbs.

W=the unbalanced weight in lbs.

v=the velocity of the revolving unbalanced weight in feet per second.

R=the radius (in feet) of the path in which W travels, =1.5 feet.

g=acceleration due to gravity, =32.2.

The only one of the above factors not yet known is the volocity (v), but since the wheel makes 4 revs. per second,

$v = 3.1416 \times 3 \text{ ft.} \times 4 = 37.7$ ft. per second.

Then the hammer blow on the rail is

$$\frac{3 \times 37.7 \times 37.7}{32.2 \times 1.5} = 88.27 \text{ lbs.}$$

* * *

Question.—Find the weight of a hollow cast iron cylinder 30 inches long, 18 inches outside diameter and 14 inches inside diameter. Cast iron weighs 0.26 lbs. per cubic inch.

Answer.—To find the number of cubic inches of metal in the cylinder, subtract the inside area of the cylinder from the outside area, and multiply the result by the length of the cylinder. Take all dimensions in inches and the result will be in cubic inches. Next multiply the cubic inches by 0.26, and the answer will be the weightof the cylinder in pounds.

Area of 18 inches $= .7854 \times 18 \times 18 =$ 254.47 sq. inches.

Area of 14 inches $= .7854 \times 14 \times 14 =$ 153.93 sq. inches.

Weight of cylinder is

$(254.47 - 153.93 \times 30 \times .26 = 784.2$ lbs.

* * *

Question.—How many Imperial gallons of water are contained in a rectangular tank, 6 feet long by 4 feet wide by 8 feet deep? One Imperial gallon occupies a space of 0.16 cubic feet.

Answer.—The cubic contents of the tank are

$6 \times 4 \times 8 = 192$ cubic feet,

$$\text{therefore contents} = \frac{192}{0.16} = 1{,}200 \text{ gals.}$$

* * *

Question.—A cylindrical welded steel tank, open at the top, is made of ¼-inch plate. It has an internal diameter of 36 inches and an inside depth of 5 feet. It is filled to a depth of 50 inches with sperm oil, weighing 8.81 lbs. per gallon. Steel plate weighs 0.283 lbs. per cubic inch, and one gallon occupies a space of 277,274 cubic inches. or 0.16 cubic feet. What is the combined weight of the tank and its contents?

Answer.—Since the tank is welded, there are no rivets, lap joints or angle irons to be considered. First calculate the number of cubic inches of metal in the tank. The thickness of the tank is ¼ inch; therefore, the mean diameter is 36¼ inches, and the number of cubic inches in the vertical walls of the tank is

$3.1416 \times 36.25 \times 60 \times .25 = 1708.25$ cub. ins.

To this must be added the base of the tank, or

$.7854 \times 36.5 \times 36.5 \times 25 = 261.58$ cub. ins.

The weight of the tank is therefore

$(1708.25 + 261.58) \times .283 = 557.46$ lbs.

The space occupied by the oil is

$.7854 \times 36 \times 36 \times 50 = 50894$ cub. ins.

And the number of gallons in this space is

$$\frac{50894}{277.274} = 183.5 \text{ gals.}$$

The weight of the oil is

$183.5 \times 8.81 = 1616.63$ lbs.

Then the total weight of tank and contents is

$557.46 + 1616.63 = 2174.09$ lbs.

* * *

Question.—A stationary engineer has a cylindrical oil storage tank 24 inches inside diameter. It has a flat bottom, and on measurement he finds the depth of oil remaining in the tank to be 18⅜ inches. How many gallons of oil has he in the tank? Consult the previous question for the number of cubic inches in a gallon.

Answer.—The number of cubic inches of oil is

$.7854 \times 24 \times 24 \times 18.375 = 8312.66$ cub. ins.

Then, the number of gallons in the tank is

$$\frac{8312.66}{277.274} = 30 \text{ gals. (nearly).}$$

* * *

Question.—What weight can be raised by a single geared steam winch, of which the following are the particulars? It has two double acting steam cylinders, 8 inches diameter by 10 inches stroke; mean effective steam pressure in cylinders, 90 lbs. per sq. inch; number of revolutions per minute of engine shaft, 120; pinion on engine shaft, 16 teeth; gear wheel on winch 180 teeth; diameter of winding drum, 15 inches. The overall efficiency of the whole machine is 40 per cent.

Answer.—The horse-power developed by the engine is

$$\frac{2\times90\times.7854\times8\times8\times10\times240}{33{,}000\times12}=54.8 \text{ h.p.}$$

This is equal to 54.8×33,000=1,808,400 ft. lbs. of work per minute.

The gearing has a ratio of 16 teeth to 180 teeth; so the number of revolutions per minute made by the winding drum is

$$\frac{120\times16}{180} = 10.66 \text{ r.p.m.}$$

Therefore the load is raised at the rate of

$$\frac{3.1416\times15\times10.66}{12} = 41.86 \text{ ft. per min.}$$

By the "Principle of Work" the work put into a machine is equal to the work absorbed by the machine plus the work given out by the machine; and the work put in, as found above, is 1,808,400 ft.-lbs. per minute. We are told that the efficiency of the machine is 40 per cent. In other words 60 per cent. of the work put in is absorbed in overcoming friction, so the useful work got out of the machine is only

$$\frac{1{,}808{,}400\times40}{100} = 723{,}360 \text{ ft.lbs. per min.}$$

We have seen that the weight is raised at the rate of 41.86 feet per minute; therefore the weight which the winch can raise at this speed is the number of ft.-lbs. of work got out of the machine in one minute divided by the number of feet through which the weight is raised in the same time, or

$$\frac{723{,}360}{41.86} = 17{,}280 \text{ lbs.}=\text{weight raised}$$

* * *

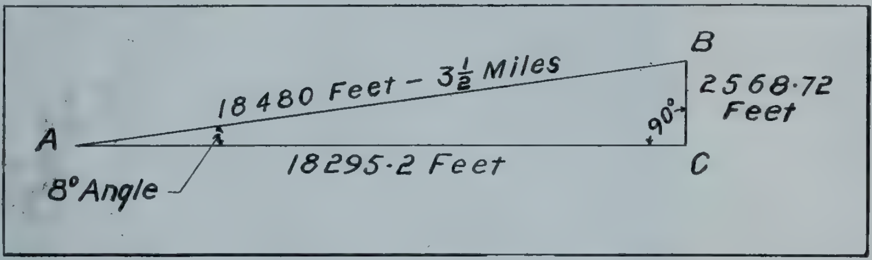
Question.—A car of 20,000 lbs. weight ascends an inclined plane of 8 degrees grade, 3½ miles long, in 15 minutes. If the friction be 3 per cent. of the load, what is the horse-power absorbed?

Answer.—Referring to the diagram herewith, let the triangle (ABC) represent the inclined plane. The angle at (A) is 8 degrees, and the distance (AB) is 3½ miles, or 18,480 feet. Now, the total work done in moving the car to the top of the incline is equal to the work done in moving it against friction through the horizontal distance (AC), plus the work done in lifting it through the vertical height (BC); consequently the first thing to do in seeking a solution is to calculate the lengths of the sides (AC) and (BC) of the triangle. Find (AC) first.

Cos. A = Cos. 8 = .99, but Cos. A $= \frac{AC}{AB}$, therefore $\frac{AC}{AB} = .99$.

AB = 18,480 feet, therefore $\frac{AC}{18{,}480} = .99$, and AC = 18,480×.99 = 18,295.2 feet.

Next find the height of the side BC, $\frac{BC}{AB}$ = Sin. A = .139, therefore $\frac{BC}{18{,}480} = .139$, or BC = 18,480 × .139 = 2,568.72 feet.



SOLUTION OF HORSE-POWER PROBLEM.

Now, the work done against friction is 3 per cent. of 20,000 lbs., or 600 lbs., moved through the distance (AC), or 18,295.2 feet, and this amount of work is equivalent to

600×18,295.2 = 10,977,120 ft.-lbs.

Again the work done in lifting the car through the height (BC) is 20,000 ×2,568.72 = 51,374,400 ft.-lbs., therefore the total work done is 10,977,120+ 51,374,400 = 62,351,520 ft.-lbs.

This amount of work is done in 15 minutes; therefore the work done in one minute is $\frac{62{,}351{,}520}{15} = 4{,}156{,}768$ ft.-lbs., and the horse-power exerted is

$$\frac{4{,}156{,}768}{33{,}000} = 126 \text{ h.p. (nearly).}$$

* * *

Question. — How long must a mild steel bar be so that, if lowered vertically into the sea, it would break with its own weight?

Answer.—Consider a cross section of 1 square inch. One foot of steel one inch square weighs 3.4008 pounds, and has a breaking strength of 60,000 lbs., and one foot of sea water one inch square weighs .4461 pounds. The net weight of 1 ft. of steel of 1 inch cross section when immersed is therefore, 2.9547 pounds, and the length necessary to produce a stress of 60,000 pounds would be $\frac{60000}{2.9547}$ or 20,318 feet.

* * *

Question.—The ram of a hydraulic elevator is 10 inches in diameter. The unbalanced weight of the elevator is 500 pounds. What hydrostatic pressure would be required to raise 2½ tons?

Answer.—Total pressure on ram is 5500 pounds. Area of ram cross section is 78.54 sq. ins., therefore 5500 pounds distributed over 78.54 sq. in. would require a pressure of $\frac{5500}{78.54} = 70.028$ lbs. per sq. in. or approximately 70 pounds per sq. in. in the receiver tank.

Question.—A Prony brake, with a lever arm 5 feet long was applied to a pulley running 275 revolutions per min. The lever was found to balance at 70 pounds on the scale pan. How much power did the brake absorb?

Answer.—Applying formula

$$\frac{2\times\frac{22}{7}\times r\times W\times N}{33{,}000} = \text{h.p. in which}$$

r = length of brake arm
W = weight on scale pan
N = r.p.m. of pulley, then

$$\frac{2\times\frac{22}{7}\times5\times70\times275}{33{,}000} = 18.66 = \text{h.p.}$$

* * *

Question.—A 48-inch cylinder is to be bored. How many revolutions per minute should the table of the mill make in order to give a cutting speed of 50 feet per minute?

Answer.—Circumference of 48-inch circle would be 48×3.1416 = 150.7968 inches, and number of revolutions required =

$$\frac{50\times12}{150.7968} = 3.97 \text{ or approx. 4 r.p.m.}$$

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

THE SIEVERKROPP ENGINE.

THE gasoline engine here illustrated has many features of interest to users of small power units for operating cream separators, small air compressors, feed grinders, etc. It is an entirely new type of two-cycle engine.

Referring to the illustration, it will be noticed that there are two pistons (3 and 4), acting on one connecting rod (16). The tops of the two cylinders are in communication with each other by means of the passage (C). As the pistons move upwards from the position shown in the cut, they create a partial vacuum in the airtight space below. When the intake port (12) is uncovered, air rushes in, creating a suction in the fuel pipe (13). As the gasoline arrives at the end of the suction pipe in the neck of the mixer, it is immediately atomized by the passing air and becomes thoroughly mixed with it.

The two cylinders are entirely cut off from the crank case, but are connected at the bottom by a channel or passage (A). The mixture thus fills the space under both pistons and also the insides of them. It does not, however, fill the crank case. As the pistons start on the downward stroke, the mixture intake port (12) is covered by the piston (4), which traps and slightly compresses the mixture until the piston (3) uncovers the intake port in the right-hand cylinder, when the mixture at once rushes in and fills the upper ends of both cylinders.

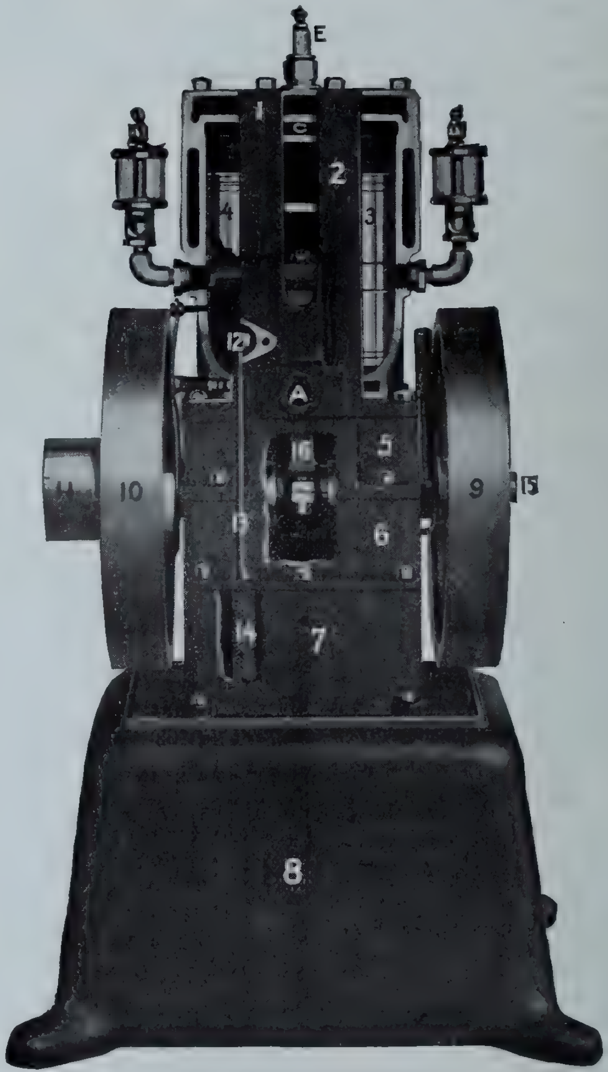
The inrush of the new mixture into the right-hand cylinder drives before it all of the remaining burnt gases through the passage (C) into the left-hand cylinder and on out through the exhaust port, which opens just before the intake port. Immediately the pistons start on the upstroke, the intake and exhaust ports are covered, and the fresh mixture is trapped in the top of the cylinders and compressed into a very small space in the cap. Just as the pistons reach the highest point, the compressed charge is fired by the spark plug (E), and the explosion that follows drives the pistons downwards, completing the cycle.

Before the pistons reach the lowest point of their stroke, the exhaust port opens, allowing the burnt gases to escape through the muffler. The intake again opens and the new charge of mixture which has been brought in on the previous up-stroke and partially compressed under the pistons, rushes into the upper parts of the cylinders, and the same action as previously described takes place.

It will be seen that, unlike other two-cycle engines, the charge is not compressed in the crank case, where it is impossible to avoid leakage at the bearings; but is compressed entirely in the airtight chambers below the pistons.

The builders claim a very low fuel consumption for this engine, which has been put on the market to fill the needs of farmers, small machine shops, motor garages, dairies, etc. It is said to be so simple that a woman or child can operate it. It is at present being built in small sizes only—½ h.p., 1 h.p., and 1½ h.p.; but the makers are now getting out designs and patterns for higher powers. They are also working on an engine of this type for motor boats.

The Foss & Hill Machinery Co., Montreal, are sole Canadian distributors for the Sieverkropp engine.



The Sieverkropp Engine.

SIEMENS BROS. DYNAMO WORKS | SIEMENS BROS. & CO.

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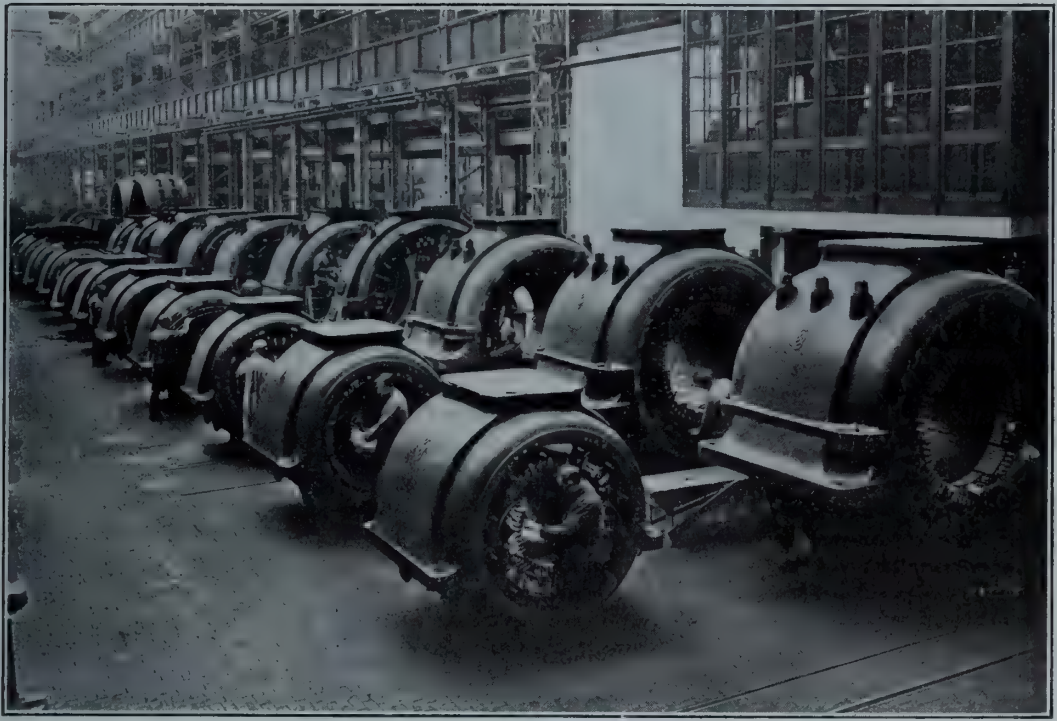


View in one of the Siemens Works showing Winding Department for Stators of Turbo Generator

The following Siemens **Turbo Generators** have been supplied or are on order for Canada:

1—4000 K.W. Edmonton.
1—3000 K.W. Regina.
1—2500 K.W. Dominion Coal Company.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Edmonton.
1—1500 K.W. Regina.
1—1500 K.W. Moose Jaw.
1—1500 K.W. Regina.
1—1200 K.W. Lethbridge.
1— 750 K.W. Nova Scotia Steel & Coal Company.
1— 675 K.W. Medicine Hat.
1— 675 K.W. Medicine Hat.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1—500 K.W. Wayagamack Pulp & Paper Company.

The Siemens Companies manufacture Turbo Generators in single units of 30,000 H.P.

Siemens Company of Canada Limited

HEAD OFFICE:

Transportation Building - MONTREAL

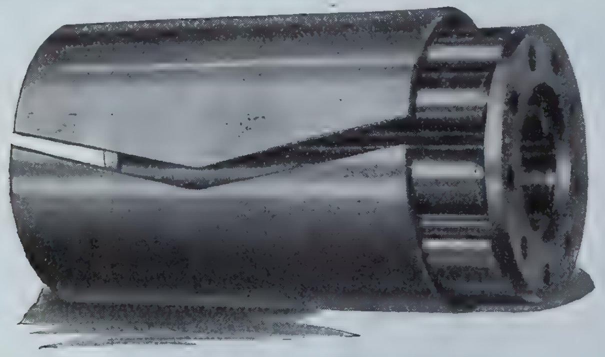
BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

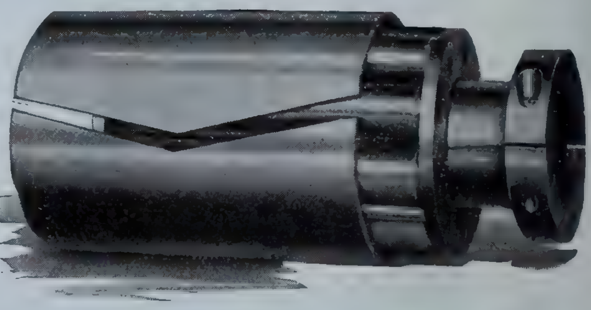
McARTHUR BUILDING
WINNIPEG

NEW LINE ROLLER BEARINGS.

A NEW and complete line of roller bearings, incorporating several new features, has recently been placed on the market for service in many forms of journal roller bearings. Every type of this line appears to bear the stamp of a careful analysis of the many conditions to be faced. A study of the accompanying illustration reveals several interesting points, chief among which seem to be ease of application, absence of roller friction, and a design that points to long bearing life.

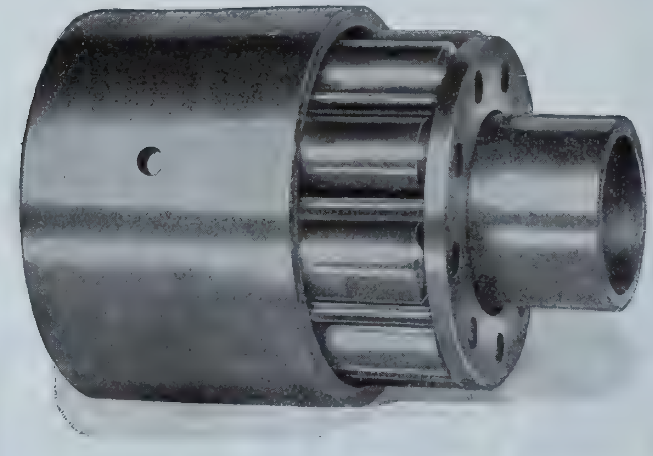


TYPE OF NEW LINE ROLLER BEARINGS.

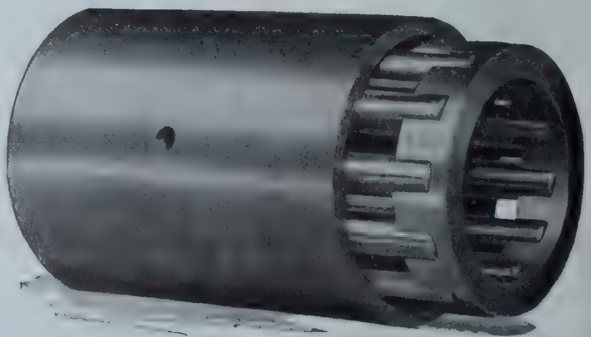


TYPE OF NEW LINE ROLLER BEARINGS.

These bearings embody the basic principles of the successful types of line-shaft bearings that the Royersford Foundry and Machine Co., Philadelphia, Pa., have been marketing for a number of years. A saving of at least twenty-five per cent. of the friction load is, we understand, guaranteed by the manufacturer, and it is reported that in many instances much higher savings have been made; which points to augmented capacity or a cheaper rate of production per machine that has been equipped. Instances are cited where a power plant which has been overloaded in driving machinery equipped with babbited bearings has run below capacity, after the substitution of these types of roller bearings.



TYPE OF NEW LINE ROLLER BEARINGS.



TYPE OF NEW LINE ROLLER BEARINGS.

The line consists of five distinct types, four of which are for use in machinery, and one in heavy wagon hubs. The first, known commercially as the "Sells Special," has a shaft-protecting feature in a split sleeve which is clamped over the shaft by two split collars. Ease of application, assurance of fit, and low-cost protection given the shaft, are advanced as prominent advantages. One of the best power-saving points in these bearings seems to be the suspension of the rollers in a permanent, revolving roller structure that keeps them constantly parallel to the shaft, and out of contact with each other; the principle being, that under such conditions, the rollers do not jamb, or become tapered; aside from the fact that their separation is said to add much to the total reduction of friction.

The entire structure is enclosed within a high-carbon steel single-piece, or "Unit Lining, which takes the action of the rollers and prevents wear of the housing. The "V" cut shown in the illustrations is to provide a diagonal joint that allows the rollers to pass over it smoothly. Another type, intended for work similar to the "Sells Special" is known as the "Sells" Commercial Type. It is actually a duplicate of the former, minus the split sleeve and collars. This bearing is said to be especially suited for journals of mine, industrial, or other light-car axles.

Two other types, designed for high-grade machinery involving heavy loads or high speeds, are the "Sells" High Duty and "Sells" Journal Bearings. They do not differ in principle, but vary somewhat in the design of the roller structures, largely because the shorter length of the former requires rollers of larger diameter to give the same capacity as the latter, with its longer rollers. Where space is not a factor, they are said to perform equally well in a given service, but where the available bearing length is limited, the high duty are recommended. They are generally used in connection with ground sleeves and casings, and for protecting the shaft and housing, when these are not specially selected for direct contact with the rollers.

◆

Boiler Explosion Finding.—The coroner's jury which has been investigating the cause of the boiler explosion at Drummond colliery, Westville, N.S., two weeks ago, which resulted in the death of five men, returned the following verdict on April 14, in the case of D. L. McMillan, one of the victims:—"That Dan L. McMillan came to his death at the Drummond colliery on April 2 by the explosion of No. 5 boiler. This jury is unable to determine the exact cause of the explosion, but from the evidence given would say that the boiler plate was not up to the standard. The jury believe that the company took all necessary precaution, but would recommend a Government inspection of all boilers."

Boiler Scale

is easy to get rid of when you KNOW HOW. A mechanical Cleaner is the only *sure way.* You may use compounds of different make, but after using them for months you will find they have failed to remove the scale and have not prevented additional accumulation.

During this experimental trial your fuel bill has been gradually increasing, and when you come to count the cost, you have paid for wasted fuel the price of several LIBERTY CLEANERS, which would have thoroughly cleaned your boilers and restored their normal capacity. LIBERTY CLEANERS are the sure way to get rid of your scale trouble. They will take out all the scale and do it quickly and economically.

One man can operate any of our Cleaners, while it requires three or more men to run a power Cleaner. If you wish to economize in your operating expenses, throw away your compounds, power Cleaners and other types of cheaply made, inefficient Cleaners and put a LIBERTY on the job.

We furnish Cleaners for every type of boiler and to be operated by water, air or steam, to suit your conditions.

Write for descriptive catalog.

Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

"TWINS" EXCITE ADMIRATION

Because They Earn It

Think of a TWIN when you hear the word STRAINER

The installation of a Twin Strainer on your water supply line eliminates troubles, worry, waste of time and expense—because

It has two straining baskets—that may be cleaned alternately, thus permitting continuous operation.

It has but two valves—they are of the gate type and are always tight.

It gives a direct flow with minimum friction loss, insuring easy operation with no waste of energy.

In fact, a Twin Strainer is an insurance policy in active service.

Designed to protect and built to last.

Write for our bulletin.

THE TWIN STRAINER.

ELLIOTT COMPANY

6902 Susquehanna Street, PITTSBURGH, PA.

Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

Trade Gossip

Chas. Barber & Sons, Meaford, Ont., have received an order from Moirs, Ltd., Halifax, for a water turbine.

Prince Rupert, B.C.—The town has placed an order with Gerald Lomer, Ltd., Montreal, for a quantity of 18 in. and 45 in., steel piping at a cost of $86,000.

Montreal, Que. — Armstrong Whitworth Co., Montreal, have placed an order with Bruce, Peebles, Ltd., Edinburgh, Scotland, for two 350 k.w. motor converter sets.

Fraser & Chalmers of Canada, Ltd., 4 Phillips Place, Montreal, have been appointed Canadian agents for W. H. Allen, Son & Co., Bedford, England, builders of steam, hydraulic, and electrical machinery.

The Dominion Machinery Co., of 249 Victoria St., have moved their office to 82 Adelaide St. East., Toronto, where they carry a large stock of transmission equipment, also a number of hydro electric motors from 1 to 30 h.p.

Ottawa, Ont.—Owing to the increased consumption of municipal electric power and current it has been found necessary to enlarge the municipal plant on Laurier avenue. The extensions will be made this spring. The plant will be extended back as far as the canal.

The Siemens Co. of Canada, Ltd., Montreal, have received an order from the Union Carbide Co., of Welland, Ont., for some 46,000 volt single conductor cable. The cable will be paper insulated and lead covered, and will be made to withstand a test of 100,000 volts.

Siemens Co., of Canada, Ltd., have received an order for 2 and 4-core submarine cable for service between Prince Edward Island and Nova Scotia, the total length in all being 28 miles. The 2-core cable is for telephonic purposes and the 4-core cable is for telephonic and telegraphic purposes.

The General Supply Co., Winnipeg, who are Western distributers for the Beardmore Belting Co., have installed two 36-inch presses, and are now in a position to handle the belting business in proper manner. They have a large stock, and claim to have facilities unsurpassed between Toronto and Winnipeg.

Peebles Motor Converters for Canada.—Bruce Peebles & Co., of Edinburgh, Scotland, have just received the following orders for their well-known motor converters (Peebles-laCour patents):—Armstrong, Whitworth & Co., Ltd., Longueuil, Que., two 350 k.w. sets; Canada Cement Co., one 250 k.w. set. The Armstrong, Whitworth order includes various switch gear, etc.

The Siemens Co. of Canada, Ltd., Montreal, have received an order for over 700 water meters for the City of Edmonton. They will be of the vane type with frost protection. The order also comprises several compound meters with double ported valves and hydraulic balance, which is a special feature.

The Babcock & Wilcox Co. have been awarded a contract by the Brompton Pulp and Paper Co., Ltd., Sherbrooke, Que., for four 300 h.p. boilers, complete with superheaters and chain-grates. They have also received an order for three 219 h.p. boilers, steel cased, from the University of Alberta, Edmonton.

Business Absorption.—The business of the Tungstolier Co. of Canada has been taken over by the Canadian General Electric Co., Ltd., Toronto, etc. It is the intention to carry in stock a large assortment of electric fixtures for both commercial and residential lighting, and the Canadian General Electric Co. being equipped with an up-to-date fixture factory, will be able to give the very best service in this respect.

Westinghouse, Church, Kerr & Co., Montreal and New York, have been retained by the Canadian Pacific Railway as engineers to investigate the matter of the proposed electrification of the new double-track, 5½-mile Selkirk tunnel, in British Columbia. The investigations will cover in general the particular system to be installed, the relative economies of steam and water power, and the effect of the electrification upon operating conditions.

The Smart Turner Machine Co., Hamilton, Ont., have recently supplied the following equipment: The Deloro Mining and Reduction Co., Deloro, Ont., power vacuum pump; the Great Lakes Dredging Co., Port Arthur, Ont., vacuum pump; W. H. Batt, Charlottetown, P.E.I., combined air and circulating pump; the Western Construction Co., Courtright, Ont., centrifugal pump; Barfelt & Co., London, Ont., centrifugal pump; the Canada Sugar Refining Co., Montreal, duplex pump; the Goderich Lumber and Milling Co., Goderich, Ont., duplex pump; the Hinde & Dauch Paper Co., Toronto, triplex power pump.

The Turbine Equipment Co., Toronto, report recent sales as follows:—Two De Laval multi-stage motor driven pumps with capacity of 700 gallons per minute against 216 ft. head, and two De Laval single stage motor driven pumps with capacity of 600 gallons per minute against 112 ft. head., for the Canadian Copper Co., Whitson Lake water supply; one De Laval centrifugal pump with capacity of 400 gallons per minute against 70 ft. total head for J. R. Booth, Ottawa. This pump will have a motor mounted on one side and a De Laval steam turbine on the other.

The Crystal Ice Makers, Ltd., are building a plant for manufacturing artificial ice for domestic purposes, in the Ashbridges Bay industrial district, Toronto. A fifty-ton "York" ice machine will be installed as an initial unit, followed by another of the same capacity later. The machine will be installed so that it can be operated by either a steam engine or electric motor. The raw water will be purified by electricity by means of an apparatus invented by Mr. George Bury, the president of the company. It is expected that the plant will be in operation by July 1. The company is capitalized at $300,000 and has an office at 2 Toronto street, Toronto.

The York Mfg. Co., York, Pa., have recently made the following installations in Canada: R. Barron, Ltd., Toronto, Ont.; One 11-ton vertical single-acting belt-driven enclosed type refrigerating machine and high pressure side complete; O. W. Kaufman, Hagersville, Ont., one 4-ton vertical single-acting belt driven enclosed type refrigerating machine and high pressure side complete; Ryerson Bros., Ltd., Brantford, Ont., one 4-ton vertical single-acting belt driven enclosed type refrigerating machine and high pressure side complete; T. Long & Bros., Ltd., Collingwood, Ont., one 17-ton vertical single-acting belt driven enclosed type refrigerating machine and high pressure side complete; J. Y. Parkhill & Co., Ltd., Kingston, Ont., one 5-ton vertical single-acting belt driven enclosed type refrigerating machine and high pressure side complete.

Catalogues

The Dominion Machinery Co., 82 Adelaide street, east, have been appointed agents for the Frankfort furnace, manufactured by Strong, Carlisle & Hammond, Co., Cleveland, Ohio, and for the "Corona" high speed ball bearing drill, manufactured by Wright & Wood, Ltd., Halifax, Eng.

Overcoming Belt Troubles.—"How a central station can overcome its belt troubles," is the name of a pamphlet just published by the Cling-Surface Co., Buffalo, N.Y. The matter contained in its pages will prove of much value to the engineer of any central station where belts are used. The slack belt is strongly advocated. Pictures of various kinds of drives are shown and technical information is given descriptive of each drive.

The Arctic-Pownall Shell Brine Cooler is the subject of bulletin No. 5, published by the Arctic Ice Machine Company, Canton, Ohio. The bulletin ex-

Boiler Preservative

acts on the iron—not on the water. It is a boiler treatment in a class by itself.

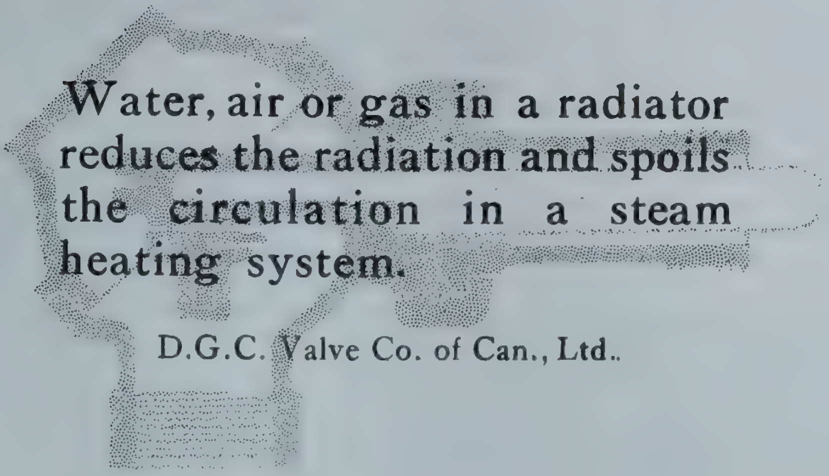
Water treatments are only partially successful, because the scale-forming sediment in water changes with seasons, climates and localities.

"MAGIC" removes scale and oil first, and then prevents scale forming. It stops pitting, corrosion and minor leaks.

"MAGIC" saves the boiler and much labor.

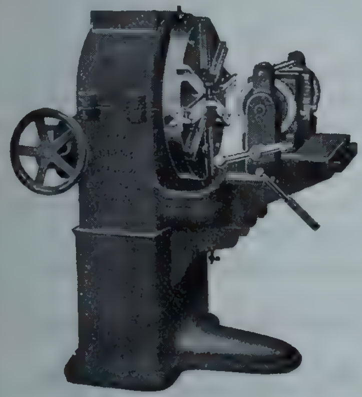
A trial will convince you—write us.

Canada Supply & Contracting Co., Limited
220 King St. W., Toronto, Ont.



Water, air or gas in a radiator reduces the radiation and spoils the circulation in a steam heating system.

D.G.C. Valve Co. of Can., Ltd..



No. 3 PIPE MACHINE
THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES
A Very Desirable Machine for
PLUMBERS and STEAM FITTERS
Manufactured by
THE ARMSTRONG MFG. CO.
298 KNOWLTON ST.
BRIDGEPORT, CONN.
Write for Catalog
NEW YORK CHICAGO

Premier Die-Stocks

Thread pipe 1 to 2 inch Right and 1 to 2 inch Left with one set of dies

Automatic Receding

Starts itself on the pipe, also automatically throws itself out after a "Briggs" Standard Thread is cut instead of backing off, which spoils the dies.

No trouble with leader screws and nuts. The new patented off-set die, which can be used **only** in the "Premier," has overcome these difficulties

No bushings to carry around or lose. The Die enables the user to accomplish, by going over the pipe once, what any other make would in going over twice.

Very easily operated.

Let us get you fully acquainted with its merits

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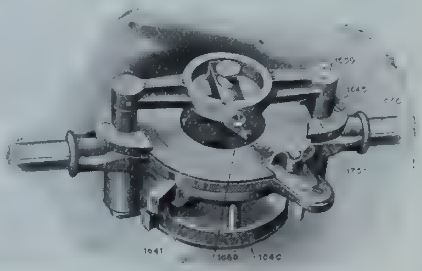

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66 Richmond St. East, TORONTO, ONT.

How Much Are You Paying for Boiler Scale?

Do you know what your cost of steam production is, compared with what it costs some of your neighbors?

There are engineers who are making steam for two-thirds what it costs you. And they are doing it only because they keep their boilers free from scale with the

Dean Boiler Tube Cleaner

We would like to show you how we can help you to knock out the "scale cost" from your expense account.

Our booklet "Scale Removal Made Easy" points out the sane, safe and economical way to fight scale.

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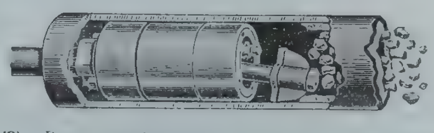
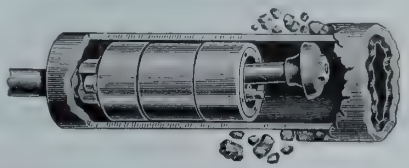


The Dean removing scale from the tube of a water tube boiler.



The Dean removing scale from the tube of a return tubular boiler.

plains the construction and operation of the "Arctic-Pownall" shell cooler and touches upon the advantages of this device for use in raw water ice-making systems. It is stated that by means of this device, the capacity of existing freezing tanks can be increased. The bulletin, which is illustrated, will be mailed to interested readers.

Heating Feed Water With Exhaust Steam is the title of Catalogue No. 51, recently issued by the National Pipe Bending Co., New Haven, Conn. The catalogue deals with heating feed water and the advantages of a closed heater, followed by a description of the "National" heater, and accompanied by several exterior and interior views showing the general construction. Tables are included, giving the dimensions and weights of the various sizes.

Ronald Trist & Co., Ltd., London, Eng., have sent us a smart-looking bulletin dealing with the "Thermo-feed" Differential Pump Governor which they manufacture. A comprehensive description is given of the governor, with special reference to its principal features, together with an excellent illustration. A leaflet containing the working details is enclosed with the bulletin. The leaflet shows a sectional view of the "Thermo-feed" Governor, each part being numbered, and its method of working described very clearly. Copies may be obtained by writing.

Oil Filtration is the title of a new catalogue which we have received from S. F. Bowser & Co., Fort Wayne, Ind. This is a very attractive publication, the reading matter being set in large type and the illustrations being colored and arranged so as to give a clear idea of the methods of operation of the "Bowser" oil filtering and circulating systems. The principal features of the "Bowser" systems are described fully, and some interesting charts are included. The latter pages are devoted to engine oiling systems, and include a diagram and several illustrations. Copies of this catalogue may be obtained from the Canadian branch, S. F. Bowser & Co., Toronto.

Book Reviews

Electric Switches for use in gaseous mines is the subject of bulletin No. 68, published by the Bureau of Mines, Department of the Interior, Washington, D.C. The main purpose of the investigations described in this bulletin was to obtain information upon which to base future tests of a similar character. The tests described were made with various types of electric switches to find out the most suitable for use in gaseous mines. Illustrations are given of the various switches tested, with a description of each switch and method of conducting the test, the results being carefully tabulated.

"Manitoba Engineer."—The 1914 number of the Manitoba Engineer, published by the Engineering Society of the University of Manitoba, has just been issued, and is a very comprehensive work. The issue contains several articles of live interest, particularly among those engaged in engineering and associated professions. The articles are well written, many of them being from the pen of men of high standing in the actual practice of engineering, architecture and surveying. The contributions are set off with numerous illustrations. The contents include the live topical questions of the day, and they are dealt with in a clear, concise and business-like manner. The article on road administration in the Province of Manitoba by A. McGillivray, Provincial Highway Commissioner, tells of the beneficial results to be derived from the construction of good roads. An article on New Manitoba and its mineral possibilities is contributed by Dr. R. C. Wallace. Street Illumination is dealt with by Prof. E. P. Fetherstonhaugh, and fireproof building construction by Thos. M. Goodrich. There are also articles on railway construction, and other topics

Engineers
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Marine and Power Plant
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FEED WATER HEATERS
Open Type—Closed Type
HOT WATER HEATERS, GENERATORS, CONVERTORS
Instantaneous—Storage
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AUDIFFREN-SINGRUN REFRIGERATING MACHINE

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Limited

628 Confederation Life Bldg. - - - Toronto
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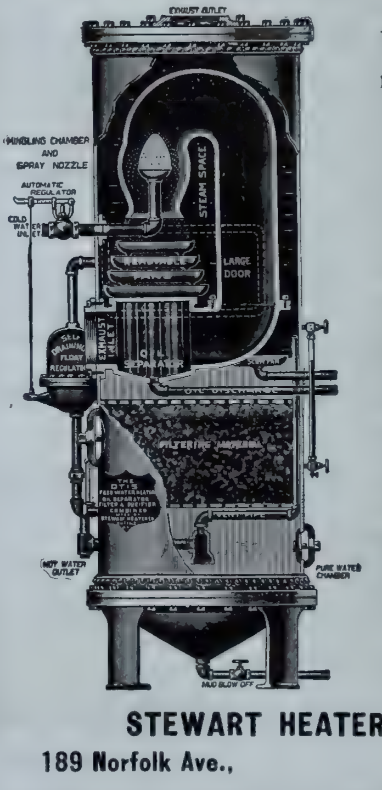
The Otis Improved Open Heater and Oil Separator with Cast Iron Pans.



This Heater is guaranteed to heat the feed water to the boiling point, 212 degrees Fahr., without any back pressure. No water can be thrown out with the exhaust steam, therefore no exhaust head will be required. Note the large cleaning door to remove the pans, also the large, deep filter and the conical bottom with blow-off pipe. Also note the cast iron float chamber containing the unsinkable copper float and brass balance regulating valve all outside of the heater and easy of access. This heater is shipped on its merits. If not found satisfactory in every respect, return at our expense. Compare with other open heaters, then note the simplicity of this. It can be used as a receiver as well.

For prices and further particulars address

STEWART HEATER COMPANY
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2 Double Duplex, high pressure Water Pumps.
5 60-in. x 16-ft. Return Tubular Boilers, allowed 125 lbs. steam.
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There is also a large quantity of shafting, pulleys, hangers, belting, tram cars and rails and turn-tables, particulars of which may be had on application.

Also, contents of machine shop, containing Planer, Drill, Lathe and Machinery, with tools necessary for repair work.

All of the above open for inspection at Parry Sound.

Also Complete Saw-mill Equipment.

The
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THE CANADIAN TURBINE WATER WHEEL
CONSERVE THE WATER POWERS
TRADE MARK.

Chas. Barber & Sons

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WATER POWER EQUIPMENT ONLY

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Model A. $1.10 per inch.

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Patent 1911

Has cutting edges of chisel shearing shape on both ends, which shave flue as clean as day it was made. Adjustable to wear—easily sharpened—strongly built. Made to do the work.

The IDEAL is the most perfect cleaner on the market to-day.

Sold on guarantee from your dealer or direct from manufacturer.

Manufactured by
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SOLID BELT DRESSING

These handy sticks, containing all the elements needed to keep a belt soft and pliable and adhesive, can be rubbed on the belt while running. Their use keeps the belt in a condition of maximum service and longest life — cuts down the belting bill and prevents delays and shutdowns. Send for Booklet No. 222, "The Proper Care of Belts."

Made in Jersey City, N.J., by the
JOSEPH DIXON CRUCIBLE CO.
Established 1827.

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Best known Metal Polish. Guaranteed forever. Largest sale in the World.

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THE PROPRIETORS OF LETTERS PATENT No. 127,080 relating to "Process of Manufacturing Iron Electrodes for Use in Alkaline Accumulators," and No. 127,081 relating to "Active Masses for Positive Electrodes of Electrical Elements, etc.," desire to dispose of the Patents or to grant Licenses to Interested Parties at reasonable terms with a view to the adequate working of the Patents in Canada.

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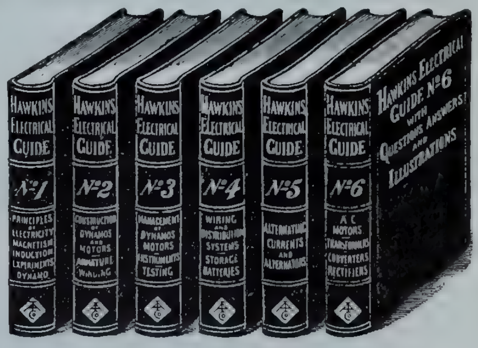
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Ship at once, prepaid the 6 numbers; if satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

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Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

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Which are always injurious to boilers and valves.

We guarantee an absolute Metal Clean Boiler, when there is sufficient exhaust steam. Get the Nobis habit around your power plant.

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Phone Adelaide 3669.

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W. C. McGHIE,
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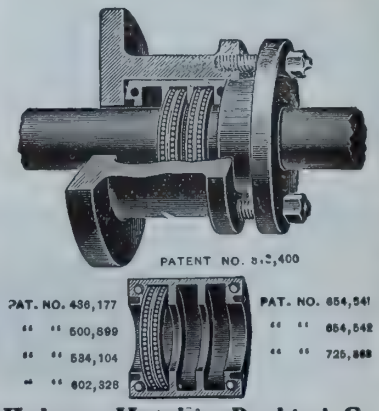
The freight and duty is the same on **high-grade coal** as on medium or low-grade coal.

Our **Lone Star** slack coal is guaranteed to show 14,000 B.T.U.'s regularly.

Our specialty in Canada is high-grade coal from Kentucky and West Virginia via Detroit.

Let us have your inquiries, and call on us if in need of **prompt shipment** via Buffalo, Car Ferry or Detroit.

Ohio & Michigan Coal Co., Detroit, Mich.



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HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

"American" Steel Split Pulleys

(made in diameters 3" to 60" inclusive)

Guaranteed to perform double belt duty under any conditions not requiring special pulleys.

PATENTED.

A grooved air escape (an exclusive "American" feature) greatly improves their belt-gripping qualities.

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CHAIN-BLOCKS

IN STOCK NOW, ¼ TO 30 TONS, AND ANY LIFT.

THE HERBERT MORRIS CRANE & HOIST CO., LIMITED,

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PETER STREET,
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FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

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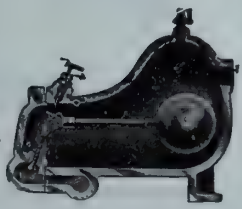

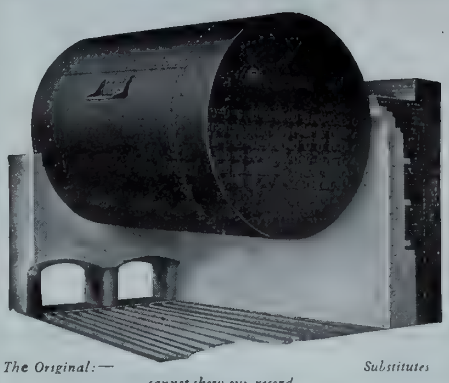

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The Betson Boiler Fire Box

Door Arches and Whole Front in one block.

Side Wall, or Both in one block.

Bridge Wall in one block.

These linings do not expand or contract and there are no bricks or mortar joints to work loose.

They are readily installed by anyone and require no special molds or forms.

Let us tell you how.

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This mark—

stands for better lubrication, at less cost; less wear on bearings and more power transmitted; because—it stands for **Lubriko.**

And Lubriko is the name of a COMPRESSION CUP GREASE of high flash-point and low cohesiveness—one that under any **circumstances,** whatever, will not gum.

Write for prices.

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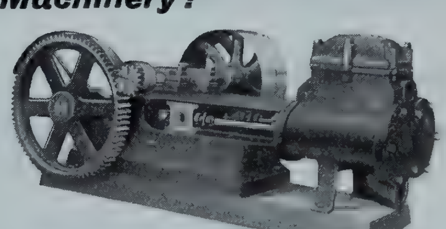
Commercial Oil Co.
Hamilton Ont.

Our first aim is to please our Customers. Why not give us a trial when next in the market for Pumping Machinery?



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Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
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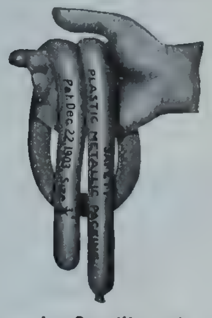
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

Manufactured only by

STEEL MILL PACKING CO., WINDSOR, ONT.

Practically Frictionless



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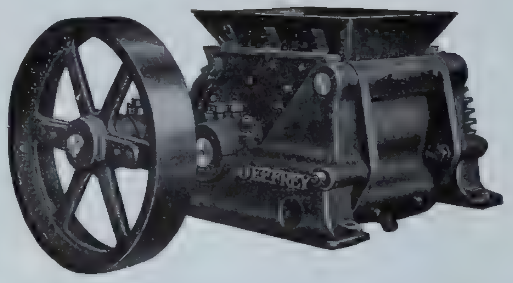

Insure a Constant Supply of Right-Sized Coal for Your Stokers.

The Jeffrey Single Roll Crusher

Reduces Run-of-mine Coal to proper size in a single operation

Receives coal in any volume without any regulating device.

Can't be flooded or choked down. Has a dependable Safety Device.

Made in three sizes for crushing 50 to 200 tons of coal per hour.

Write for Bulletin No. 41-A.

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The Detroit "500" Air Compressor Lubricator gives constant lubrication under every condition of service. The rate of feed never varies when changing from pressure to unloading or when returning from unloading to pressure.

The Detroit "500" cannot be robbed of oil and cannot be affected by changing conditions in the cylinder.

This lubricator can be started and stopped without changing the feed adjustment, preventing both loss of time and oil when starting up.

The bullseye gauge and sight feed glasses are kept tight and won't break. This lubricator will withstand the roughest service.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONTARIO

Machine Banded Wood Stave

WATERPIPES and TANKS

For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

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CONTINENTAL LIFE BUILDING
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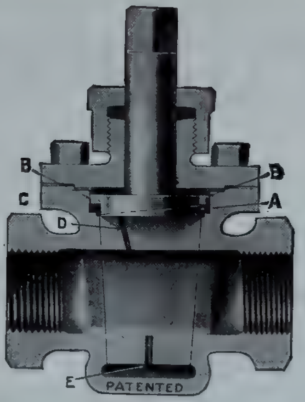


A Guaranteed Valve

For Every Purpose

Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

Send for Catalog "R."

Homestead Valve Mfg. Co.

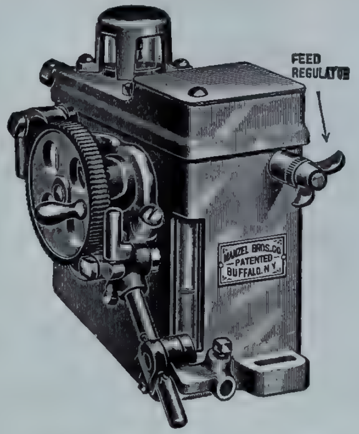
Works: Homestead, Pa. **Pittsburgh, Pa.**

Right into the Cylinder

goes every drop of oil delivered by the **Manzel Sight Feed Oil Pump.**

Right into the cylinder, where it is needed, not on the floor, or into the engine pump.

That is the secret of Manzel Efficiency. That is the reason that we can sit back and guarantee you **30 to 60% saving** in your oil bills.



And that is the reason that we can offer to lend you a Manzel Pump for 30 days, **entirely free.** And that is why we would gladly take it back at the end of that time if it did not satisfy you, but —we know you won't want to part with it then.

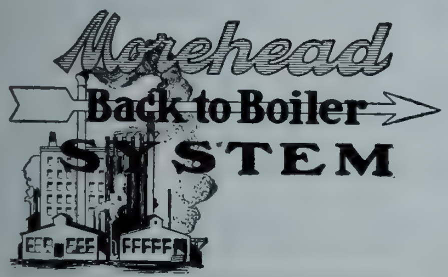
So send along to-day.

THE TWIN CITY OIL COMPANY

General Agents for Canada

BERLIN, - - ONTARIO

MANZEL BROTHERS COMPANY, BUFFALO, N.Y.



Does provide *perfect drainage* for all steam systems.

Does return *all* condensation direct to boilers.

Does handle condensation of *any degree of temperature*—as against a pump's limit of 200° F.

You Need

This perfect system which returns the water of condensation from heating, cooking or drying apparatus directly to the boiler, no matter how high the temperature, and regardless of any difference between pressure on boiler and on the apparatus drained.

And the Morehead system accomplishes these results at an operating expense far less than the cost of running pumps. The Morehead Return Trap consumes not more than 15% of the steam it takes to operate a pump—requires much less attention and fewer repairs.

Morehead Tilting Return Steam Trap. 122

Every Morehead Installation Saves Power, Fuel and Labor.
Every Morehead Trap is guaranteed to effect these savings.

Write to-day for complete information.

CANADIAN MOREHEAD MFG. CO., LTD.
WOODSTOCK, ONT.

THEODORE KIPP COMPANY

ENGINEERS

DEALERS IN MACHINERY

- Tubular and Water Tube Boilers
- Concrete Chimneys and Induced Draft Systems
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- Elevator Machinery and Transmission
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- Special Apparatus and
- Recording Instruments for All Purposes

Write us regarding your requirements.

Union Trust Building, - - Winnipeg, Man.

SUPPORT HOME INDUSTRIES

THE CANADA METAL CO., LIMITED, MANUFACTURE IN CANADA

Our **BABBITT** Sales for **1913** Have Beaten All Records

Year by year they increase by Leaps and Bounds.

The Reason:

What we make we guarantee.
Nothing is done by guesswork.

Mixtures and Physical Tests are controlled through our chemical and testing laboratories. All Babbitt Metals are tested with a friction testing machine.

This strict attention to details enables us to supply all requirements.

Ask for our booklet "Shakespeare and Babbitt Metals." Mailed free.

The Canada Metal Company, Limited

HEAD OFFICE AND FACTORY **TORONTO** BRANCH FACTORIES **Winnipeg, Montreal**

It's hard work — Scurfing

Nasty, hot, uncomfortable work, too. But it's your duty, and, like a good engineer, you put duty ahead of personal likes and dislikes.

Just a moment, though! You want to try **Walker's Electric Boiler Compound** in your feed water. It will cut out all the scale, keep your boilers clean as can be, and stop your having to do any scurfing whatever.

And mind you, it won't injure them in the slightest nor interfere with the pumps in any way.

Let us send you a barrel—to try out. If it's not up to specifications return it at our expense—there'll be no charge to you whatever.

That's a pretty fair offer, isn't it?

Then write now, we have a catalog covering all our power house supplies waiting for you.

The Electric Boiler Compound
COMPANY, LIMITED
Guelph, Ontario

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

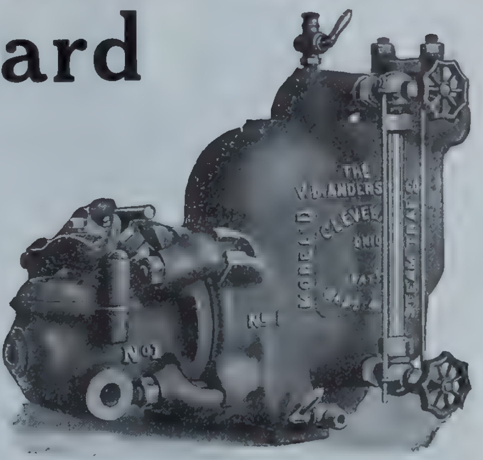
By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

A. KASTELLA
Executive Secretary
STRATFORD, - - - - ONTARIO

Always on guard



Unseen, unnoticed, live hot steam passes the ordinary sort of trap, and with it goes the precious heat units that you had to dig down deep into your pockets to obtain. Unseen, unnoticed, your good, real money slips away through the wasteful trap.

Think of every drip around your plant. Each one may, at this very moment be passing your hard-earned profits into the "Ewigkeit!"

How can you be sure that they're all working properly?

It's a difficult thing, all right!—that is, unless you install the

Anderson
Model "D" Steam Trap

Which will quickly let you forget steam—leaking drips, because the Anderson is ever on guard.

And it's all square and above board about it too! Its large, easily-read gauge glass gives you accurate reports as to how efficiently it is working; its quickly changed valve and seat makes the same trap fit in everywhere; its rugged and interchangeable construction makes it proof against senile decay.

Get the Booklet. It handles the Anderson, so as to convince you.

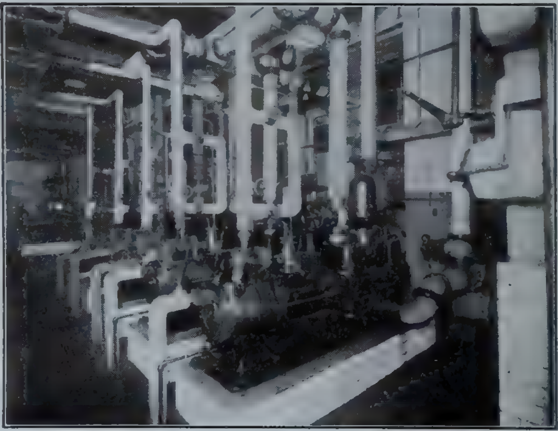
The V. D. Anderson Co.
West 96th St., Cleveland, Ohio

BRANCH OFFICES: 330 Manhattan Building, Chicago, Ill.; 6047 Jenkins Arcade, Pittsburg, Pa.; 3 Arch St., Philadelphia, Pa.; 212 Walnut St., Cincinnati, Ohio; 207 Union Trust Bldg., Baltimore, Md.; 91 High Street, Boston, Mass.

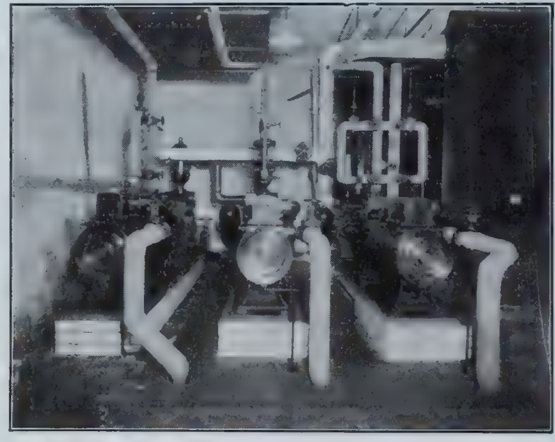
MARSH and AMERICAN
Pumping Machinery
For Every Service

Accompanying cuts illustrate an installation of Marsh and American Pumps made in the new C. B. & Q. office building in Chicago, Ill.

Marsh and American Pumps will also be found in many of the largest hotels and office buildings in the United States and Canada, including the McAlpin, Knickerbocker and Clarendon Hotels in New York City, the Brevoort and Blackstone Hotels in Chicago, the new Northwestern Terminal in Chicago, the new Michigan Central Terminal in Detroit, and the Simpson Department Store, Toronto.



Boiler Feed and Vacuum Pumps.



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Marsh Pumps have been on the market for over 25 years, and continue to be the choice of discriminating engineers who desire the utmost in quality and reliability, regardless of first cost.

Our slogan: Simplex not Duplex. "To be simple is to be great."

Write for Bulletins.

AMERICAN STEAM PUMP CO.
BATTLE CREEK, MICH.

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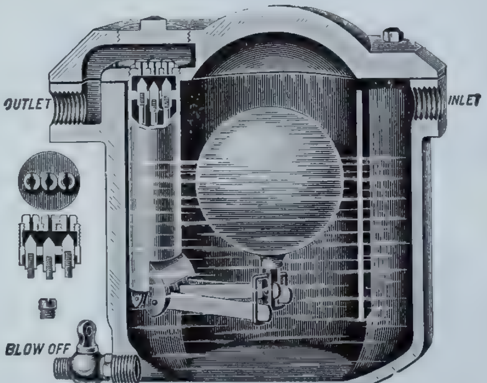

Wright
"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited
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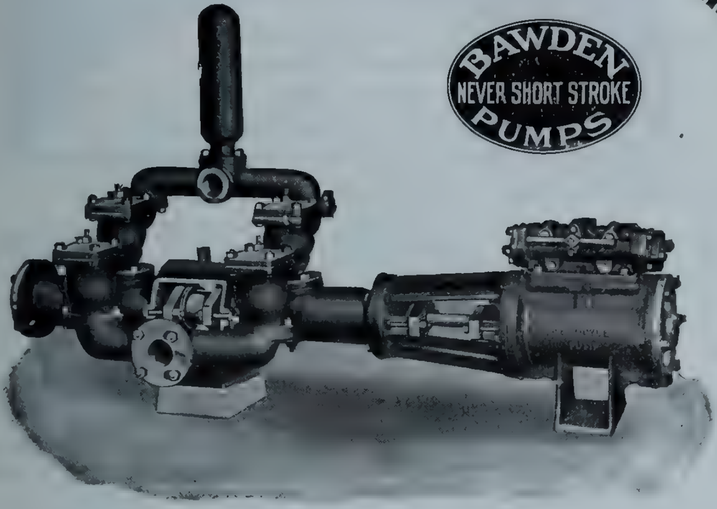
PUMPS



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It is operated by the Bawden Patent Balanced, Steam Moved Piston Valve which insures a full stroke of the piston under all conditions.

There are no outside rods to stick or get out of adjustment.

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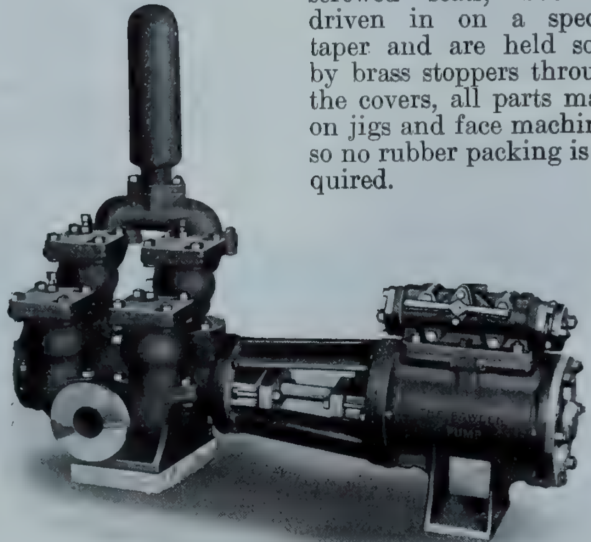

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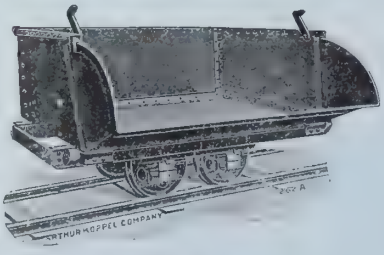

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A very important factor in the problem of keeping a constant supply of power is that of how to stoke furnaces efficiently. We are selling agents for a system of conveying coal and for charging furnaces in boiler rooms which requires very little labor and is practically indestructible. This system consists of the well known Koppel Cast Plate Track and Charging Cars.

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The rails of the track used in our boiler room systems are cast integrally with solid sectional plates, which provide a level surface to walk upon while car is being propelled.

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MAGNOLIA FIXED IT

TRADE MARK TRADE MARK

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Gentlemen:—While Engineer of the Union Grain Elevator Company in Boston in 1891, I had opportunity of using about 100 pounds of your MAGNOLIA BABBITT METAL on a bearing of a vertical shaft, which transmitted power to three 4-foot circular grist mills which ground corn and oats into meal, and which I knew to be very hard work.

One day while all three mills were being used for grinding corn, the bearing of the vertical shaft became heated, causing the babbitt in the rear of the box to become loose and revolve around one half turn under the cap, bringing all the strain on lower step located in cellar of building, which was 25 feet below. This step, so to speak, was contained in a box of oil two inches deep, the strain being so excessive after the babbitt became disengaged, that this oil in the step reached the boiling point, which notified me that something was wrong. I immediately investigated and located the trouble. I reported same to the superintendent, requesting an immediate shut-down, which I did. He inquired of me if I could repair the damage myself (having a number of rush orders on hand), and I told him I certainly could, providing he would get me the required quantity of MAGNOLIA BABBITT METAL, which he did.

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I heartily recommend MAGNOLIA METAL to all requiring a reliable and substantial job.

Wishing you every success, I remain

Yours truly,

J. H. Clemens,
211 Maverick St.,
East Boston, Mass.

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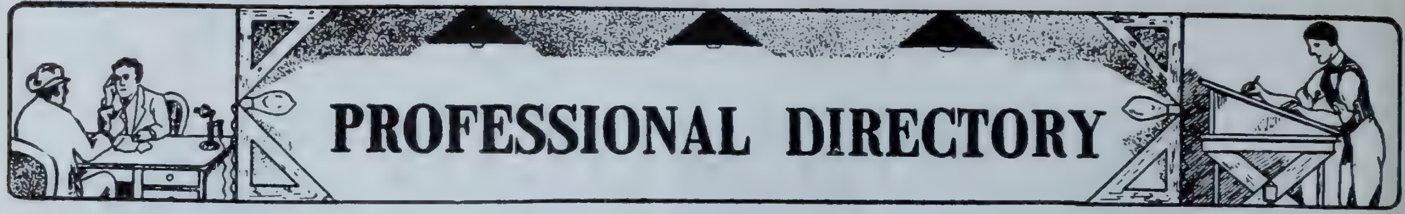

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Ten Salesmen and Ten Salesmen PLUS—

¶ Let us take two competing firms whose lines are to all intents and purposes exactly the same.

¶ Let their policies and their service be of the same high order.

¶ And let each have *ten* salesmen of average calibre and ability.

¶ All things being equal the result of the competition is a draw. It is a tug of war with an even strain on the rope.

¶ Now let one firm become dissatisfied with this even condition of affairs. Let the idea of advertising possess it.

¶ Let the idea crystalize and publicity be added to the selling force of the progressive house.

¶ Each firm still has ten men on the road. Their individual efforts remain the same, apparently, but ten of them are now reinforced by the mightiest selling force in the modern world.

¶ One firm—the advertiser—slides ahead. The other—the stand-patter—slips behind.

¶ It is inevitable.

¶ Ten men are working under a handicap. Ten men at an advantage.

¶ The tug of war is over. It is now a case of follow the leader.

¶ If you have not already put this tremendous force of advertising behind your men you ought to, and without delay.

Rate Card and full information gladly furnished.

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A Monthly Publication Devoted to the Generation, Transmission,
and Application of Steam, Gas, Electric Air and Water Power.
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With Furnaces for all Classes of Fuel or Waste Gases

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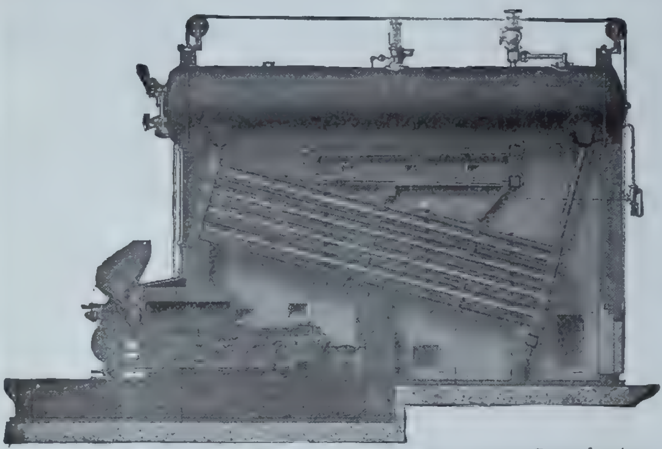

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and **ELECTRIC CRANES**

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No. 4. Does your Engineer experience any trouble in the form of foaming or priming?

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Toronto **Canada**
Office, 705 C.P.R. Building **Factory, 1220-30 Dundas Street**

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Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Geo. H. Tod, Toronto.
Theodore Kipp Co., Winnipeg.

Coal Handling Machinery
Ed. Bennis & Co., Little Hulton, Bolton. Eng.
C. W. Hunt Co., New York.
Geo. H. Tod, Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.

Coils.
Frick Co., Waynesboro, Franklin Co., Pa.

Collars.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

Cold Storage Insulation.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Robinson Bros. Cork Co., Toronto.
Kent Co., Montreal.

Condensers.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Griscom-Russell Co., New York.
John McDougall Caledonian Iron Wks, Montreal.
Waterous Engine Wks. Co., Brantford
Arctic Ice Machine Co., Canton, Ohio.

Condensers, Ammonia and Steam.
Frick Co., Waynesboro, Franklin Co. Pa.

Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
G. M. Davis Regulator Co., Chicago.

Conduits.
Can. British Eng. Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Can. H. W. Johns-Manville Co., Toronto.
Northern Electric Co., Ltd., Montreal.

Consulting Engineers.
Bayfield & Archibald, Vancouver, B.O
Chas. Bishop, M.I.C.S.A., Montreal.
de Gaspe Beaubien, Montreal.
John T. Farmer, Montreal.
Fetherstonhaugh & Co., Montreal.
Walter J. Francis, Montreal.
Jacobs & Davies, Inc., Montreal.
Pratt & Ross, Toronto.
J. M. Robertson, Montreal.
Surveyor & Frigon, Montreal.
A. V. Tracy-Gould, Montreal.

Contractors, Structural Steel.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.

Conveyor Machinery.
Can. British Eng. Co., Winnipeg.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Jeffrey Manufacturing Co., Columbus.
C. W. Hunt Co., New York.
Geo. H. Tod, Toronto.
Waterous Engine Wks. Co., Brantford

Cooler Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Cork Insert Pulleys.
American Pulley Co., Philadelphia.

Cork Insulation.
Can. H. W. Johns-Manville Co., Toronto.
Kent Co., Montreal.
Robinson Bros. Cork Co., Toronto.

Cork Tiling.
Robinson Bros. Cork Co., Toronto.

Cotton Hose.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia.

Couplings.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Jeffrey Manufacturing Co., Columbus.

Cranes, All Kinds.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Electric.
Can. British Eng. Co., Winnipeg.
Babcock & Wilcox, Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Cranes, Hand Power.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

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Cranes, Swing Jib.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Wall.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Crank and Crosshead Pin Oilers
Lunkenheimer Co., Cincinnati, O.

Crushing Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.

Cut Outs
Duncan Electrical Co., Montreal.

Damper Regulators.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Geo. H. Tod, Toronto.

Die Stocks.
Borden Canadian Co., Toronto.
Oster Mfg. Co., Cleveland, O.

Distilling Apparatus.
Frick Co., Waynesboro, Franklin Co., Pa.
Griscom-Russell Co., New York.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Double Pipe Condensers.
Frick Co., Waynesboro, Franklin Co.,

Dry Cleaners Systems.
S. F. Bowser & Co., Inc., Toronto.

Drying Machinery.
Can. Fairbanks-Morse Co., Montreal.

Dynamos.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Economizers.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.
Theodore Kipp Co., Winnipeg.

Electric Irons.
Northern Electric Co., Ltd., Montreal.

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W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
Duncan Electrical Co., Montreal.
Theodore Kipp Co., Winnipeg.
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.

Electrical Repairs.
Siemens Co. of Canada, Ltd. Montreal.

Electrical Supplies
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Northern Electric Co., Ltd., Montreal.

Elevators.
John McDougall Caledonian Iron Wks, Montreal.

Elevating Machinery.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
C. W. Hunt Co., New York.
Jeffrey Manufacturing Co., Columbus.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

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Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

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W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
International Engineering Works, Ltd., Amherst, N. S.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
W. H. Allen Son & Co., Bedford, Eng.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Kerr Engine Co., Walkerville.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brant-

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.

Evaporators.
Griscom-Russell Co., New York.

Exhaust Fans.
Griscom-Russell Co., New York.
W. H. Allen Son & Co. Bedford, Eng.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.
Griscom-Russell Co., New York.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Griscom-Russell Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
International Engineering Works, Ltd., Amherst, N. S.
Nobis Engineering Co., Toronto.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Griscom-Russell Co., New York.

Filters.
John McDougall Caledonian Iron Wks, Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.,
Theodore Kipp Co., Winnipeg.

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Economy Fuse & Mfg. Co. of Canada, Montreal.

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Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.

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Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co. Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

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S. F. Bowser & Co., Inc., Toronto.

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Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

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Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.

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The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

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Can. British Eng. Co., Winnipeg.
Griscom-Russell Co., New York.
Siemens Co. of Canada, Ltd. Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.

Gongs.
Northern Electric Co., Ltd., Montreal.

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W. H. Allen Son & Co., Bedford, Eng.

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Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Governor, Water Wheel.
Can. Allis-Chalmers, Ltd., Toronto.

Graphitol.
C. C. Snowdon, Calgary.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.

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Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
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Peterborough Machine & Lubricator Co., Ltd., Peterborough.

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Hare Eng. Co., Toronto.

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Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

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Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Heating Engineers.
Nobis Engineering Co. Toronto.
Theodore Kipp Co., Winnipeg.

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Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Nobis Engineering Co., Toronto.

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Insulators.
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Incinerators.
Griscom-Russell Co., New York.

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Can. Fairbanks-Morse Co., Montreal.

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Detroit Lubricator Co., Walkerville.

Injectors.
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Instruments.
Northern Electric Co., Ltd., Montreal.

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Northern Electric Co., Ltd., Montreal.

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Northern Electric Co., Ltd., Montreal.

Lubricants.
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C. C. Snowdon, Calgary
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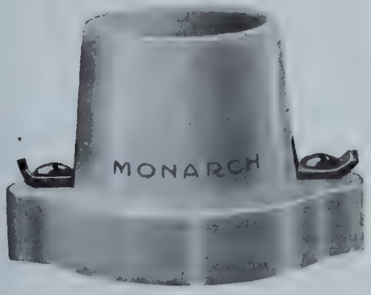

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Jenkins Bros., Ltd., Montreal.
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Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Greene Tweed & Co., New York.
Nobis Engineering Co., Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.
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Graton & Knight Mfg. Co., Worcester, Mass.
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National Pipe Bending Co., New Haven, Conn.
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Boving & Co., of Canada, Limited, Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.
Piping and Fittings.
Frick Co., Waynesboro, Franklin Co., Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.
Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.
Plate Work.
Can. Allis-Chalmers, Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

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Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Polish, Metal.
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Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
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Bawden Machine Co., Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Power Transmission Machinery.
American Pulley Co., Philadelphia.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.
Siemens Co. of Canada, Ltd. Montreal.
Pulleys.
American Pulley Co., Philadelphia.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira, Ont.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Works Co., Brantford.
Pulp Mill Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Pumping Machinery, Electrical.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
Pump Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago. Ill.
Elliott Co., Pittsburgh, Pa.
Smart - Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.
Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Pumps, Air.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek. Mich.
Boving & Co., of Canada, Limited. Toronto.
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Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.
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Smart - Turner Machine Co., Ltd., Hamilton.
Pumps, Contractors'.
W. H. Allen Son & Co., Bedford, Eng.
William Hamilton Co., Ltd., Peterborough.
Pumps, Hand and Power.
S. F. Bowser & Co., Inc., Toronto.
Pumps, Centrifugal.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Engineering Works of Canada, Ltd., Montreal.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks. Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
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Bawden Machine Co., Ltd., Toronto.
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The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

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Graton & Knight Mfg. Co., Montreal.
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The Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
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The Lunkenheimer Co., Cincinnati, O.
Manzel Cros. Co., Buffalo, N.Y.
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Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Pumps, Triplex.
William Hamilton Co., Ltd., Peterborough.
Pumps, Vacuum.
American Steam Pump Co., Battle Creek, Mich.
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Boving & Co., of Canada, Limited, Toronto.
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American Steam Pump Co., Battle Creek, Mich.
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American Pulley Co., Philadelphia.
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Chas. Bishop, Montreal.
Can. De La Vergne Co., Limited, Montreal.
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Arctic Ice Machine Co. Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Griscom-Russell Co., New York.
Theodore Kipp Co., Winnipeg.
Linde British Refrigeration Co., Montreal.
Linde Can. Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.
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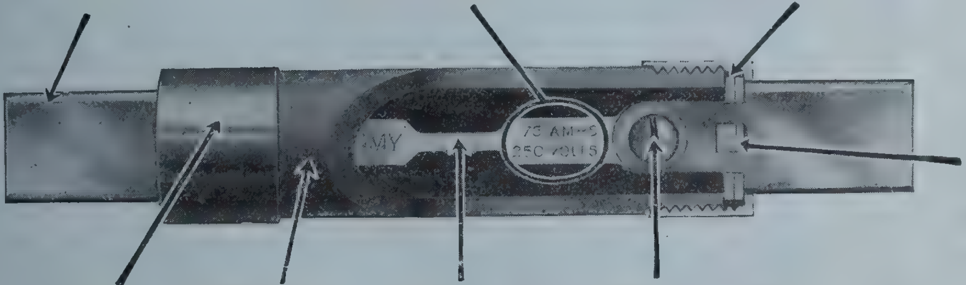

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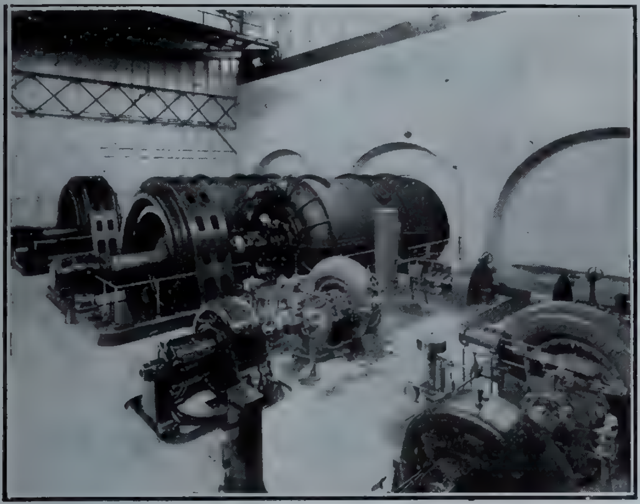

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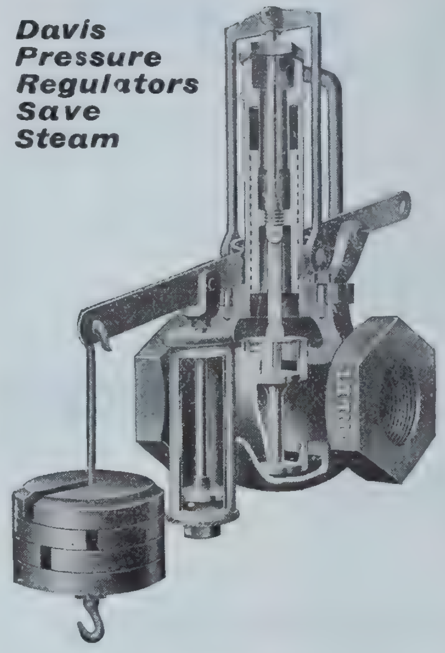

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Westinghouse

Type C Relays for Alternating Current

cover the widest possible range of application, with almost ideal operating characteristics. *All forms have the inverse time element feature.*

Overload Only—The relay alone is instantaneous at very heavy overloads, or in connection with the torque compensator gives adjustable definite minimum time at heavy overloads. This combination of inverse time element with definite minimum time is unknown in any other type of relay.

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Type C Overload Relay

Protection of Parallel Feeders is fully provided by the use of reverse power only relays in the substation, and overload only relays in the generating station.

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Genuine Hancock Inspirator for Stationary Boilers

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The J.M.T. Pop Safety Valve. Screwed or Flanged.

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WHEN CONNECTED WITH PENBERTHY "ALL QUALITY" VALVES
FOR DEPENDABLE SERVICE USE ONLY INJECTORS
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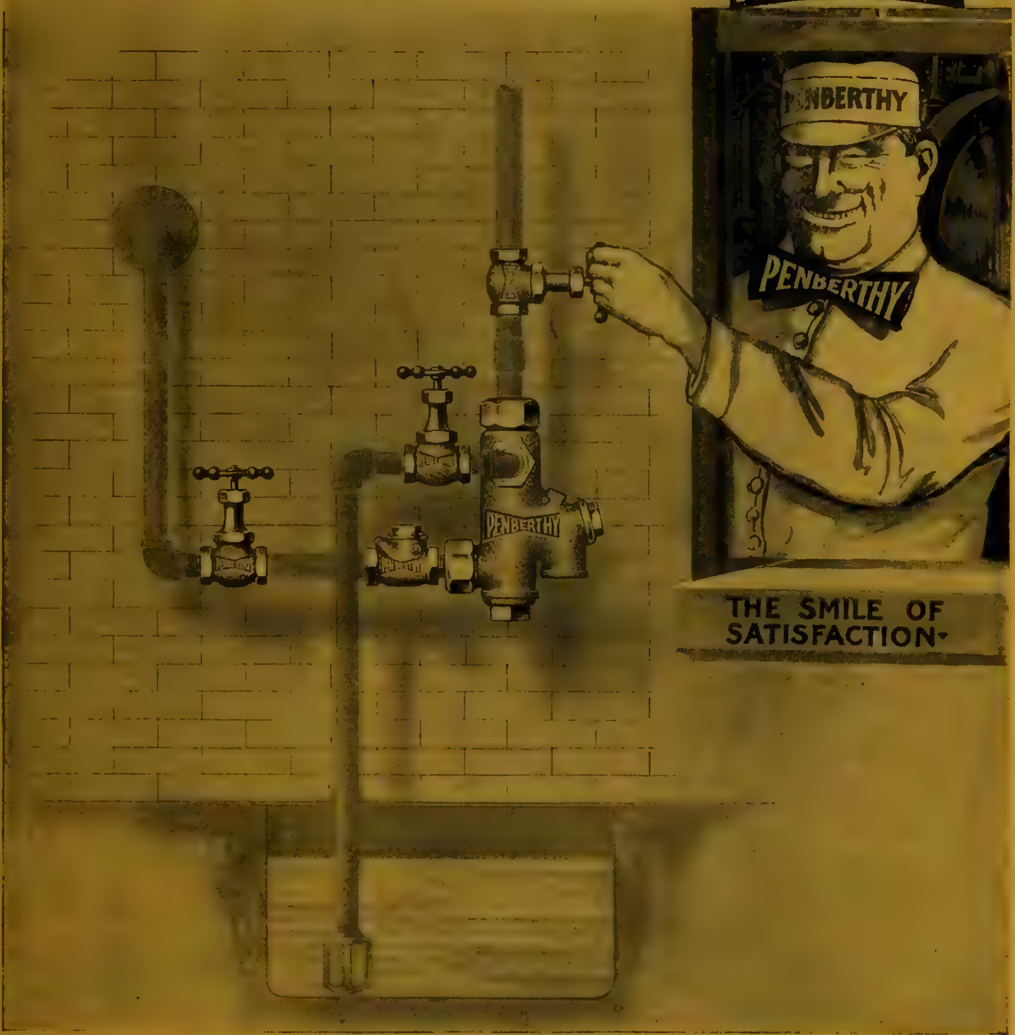

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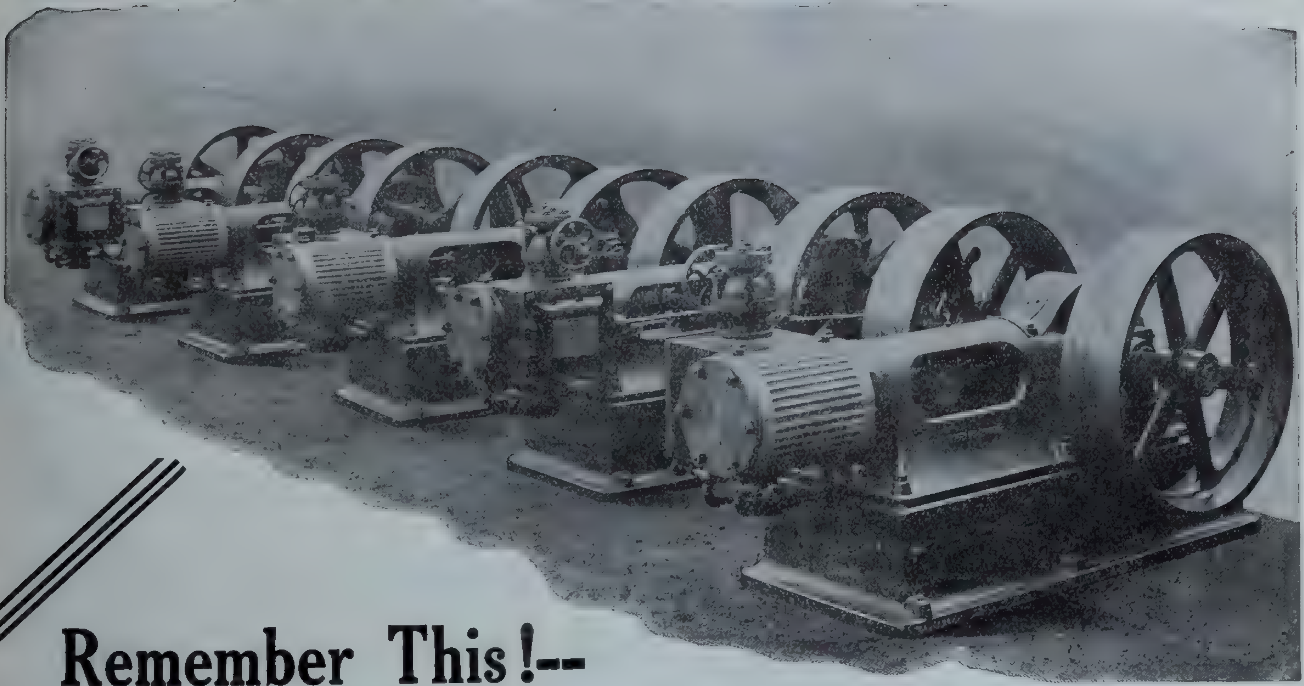

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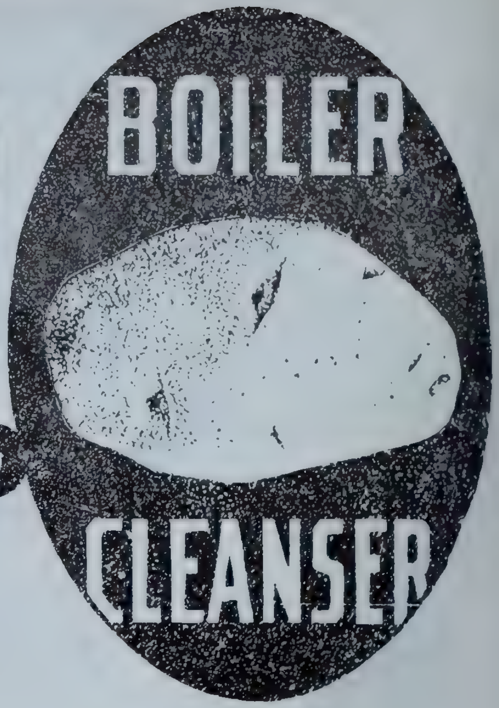

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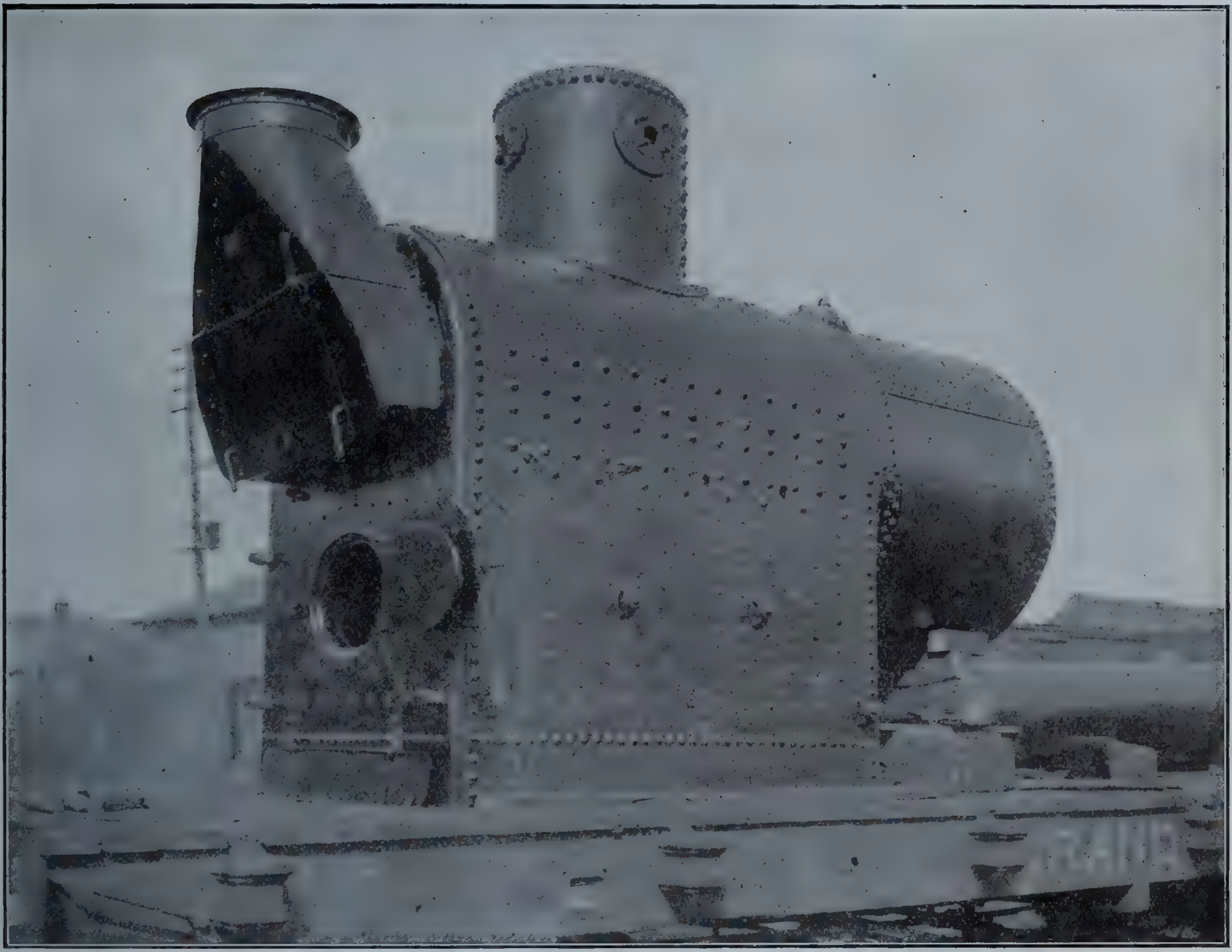

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or any grade of hard
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results, both as regards economy and
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68% AIR SPACE **90% UNDERDRAUGHT**

The "CYCLONE" contains an exclusive shaking feature possessed by no other Grate Bar. It means more vigorous and effective shaking, which is invaluable and can be explained by any user.

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The different parts of the Cyclone Grate are very strong and heavy, and few in number—and they're all protected from the heat, thus guaranteeing low repairs.

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We are prepared to instal our Grates in the Plant of any reputable Company on thirty days' trial, leaving it to the purchaser to say if the Grate is, or is not, satisfactory at the end of that time. If satisfactory, we will expect payment on the terms agreed on, and if not, we will remove the Grate from the premises without cost to the purchaser.

If you wish we will put you in touch with a few users. They'll gladly tell you how the Cyclone is serving.

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We guarantee PEROLIN, the German Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;

2. To Prevent New scale from forming;

3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;

4. To correct troubles caused by oil and grease getting into the boiler water;

5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;

6. That **PEROLIN** is not a boiler compound for water treatment, but operates independent of water conditions;

7. The **PEROLIN** preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;

8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

The easy way to eliminate the troublesome and costly scale.

The effect of Perolin is unlike that of boiler compounds.

It works through the cracks in the scale to the boiler metal, and expands, loosening the scale so that it can be easily washed out.

It forms a **preservative film** over the tubes. This film prevents scale-forming substances from adhering, is a good transmitter of heat and prevents pitting, corrosion, etc.

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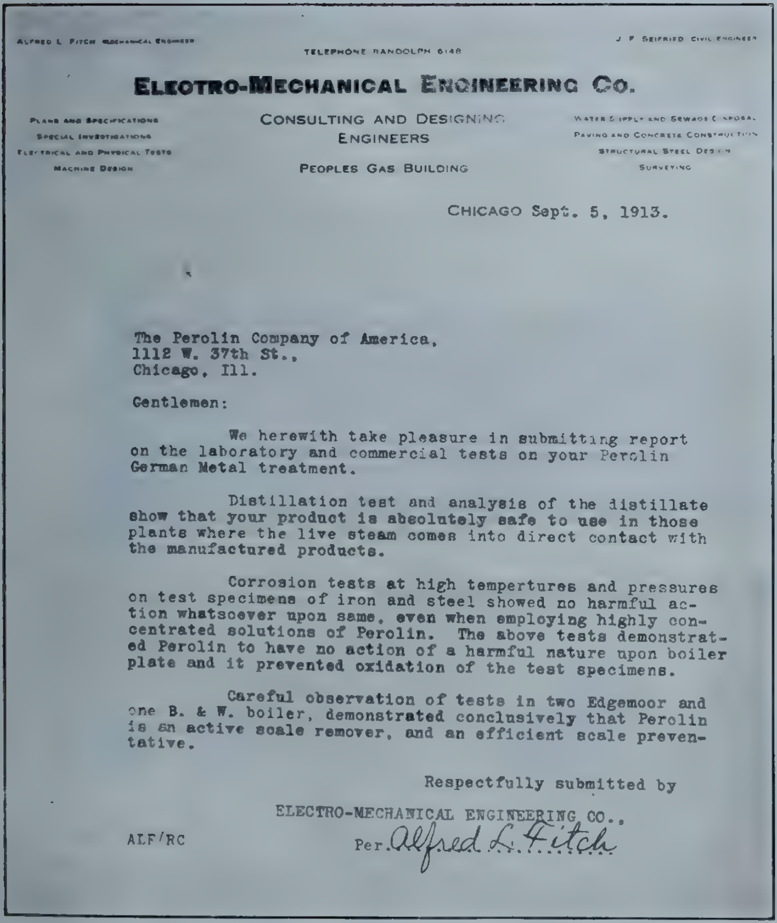

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Respectfully submitted by

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Per Alfred L. Fitch

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AND NO WONDER

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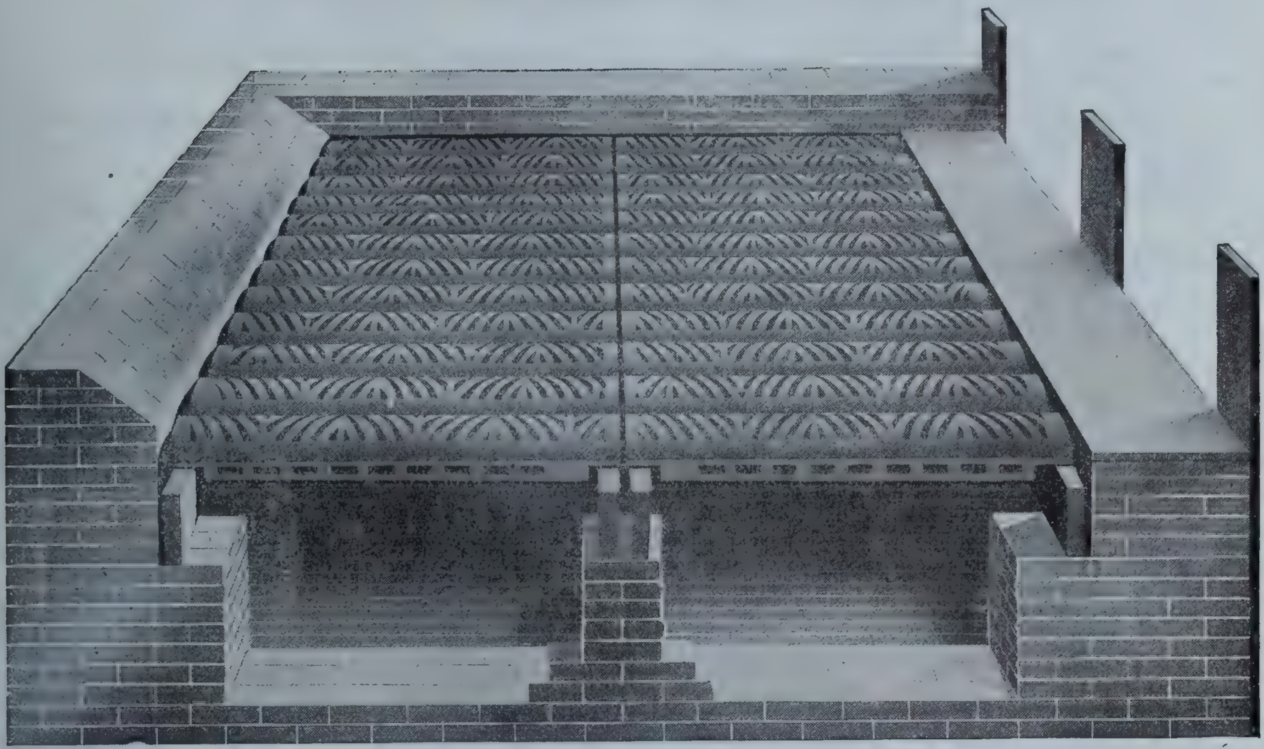
SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



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THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
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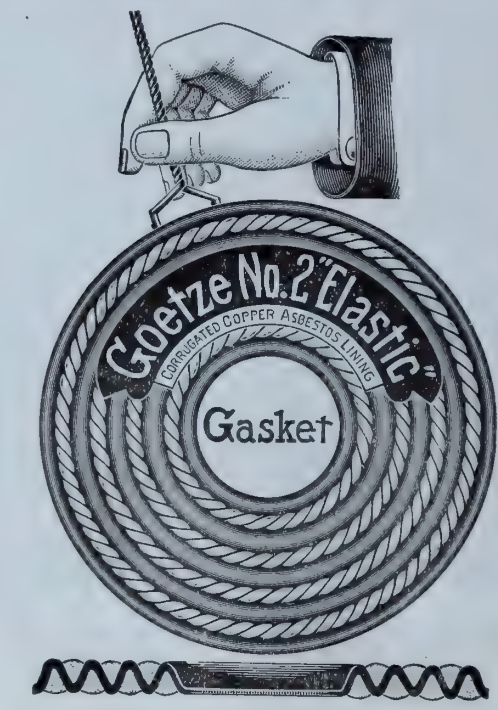
No. 2 Elastic Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight. Prevent leaks, blow outs and shut-downs. Will practically eliminate renewal expense for gaskets.

No. 2 Elastic Gaskets are for high pressure and super-heated steam lines, but owing to their indestructible nature, are equally adapted to *any and every condition* about a factory, mill or refinery.



The No. 2 Elastic Guaranteed

Every No. 2 Elastic Gasket is Guaranteed for 5 Years' Continual Service in the Same Joint

There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every No. 2 Gasket whether bought direct from us or through a dealer.

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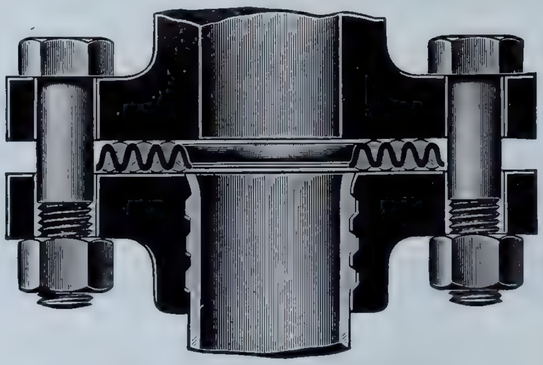

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caused by packings that do not contain lubricant but are friction producing?

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is so constructed as to permit the rod to slide along it without resistance. The bearing surface against the rod is kept in a constant state of lubrication from the packing itself, and

DOES NOT WEAR THE RODS

No matter how you consider "Palmetto" it is the packing for economy.

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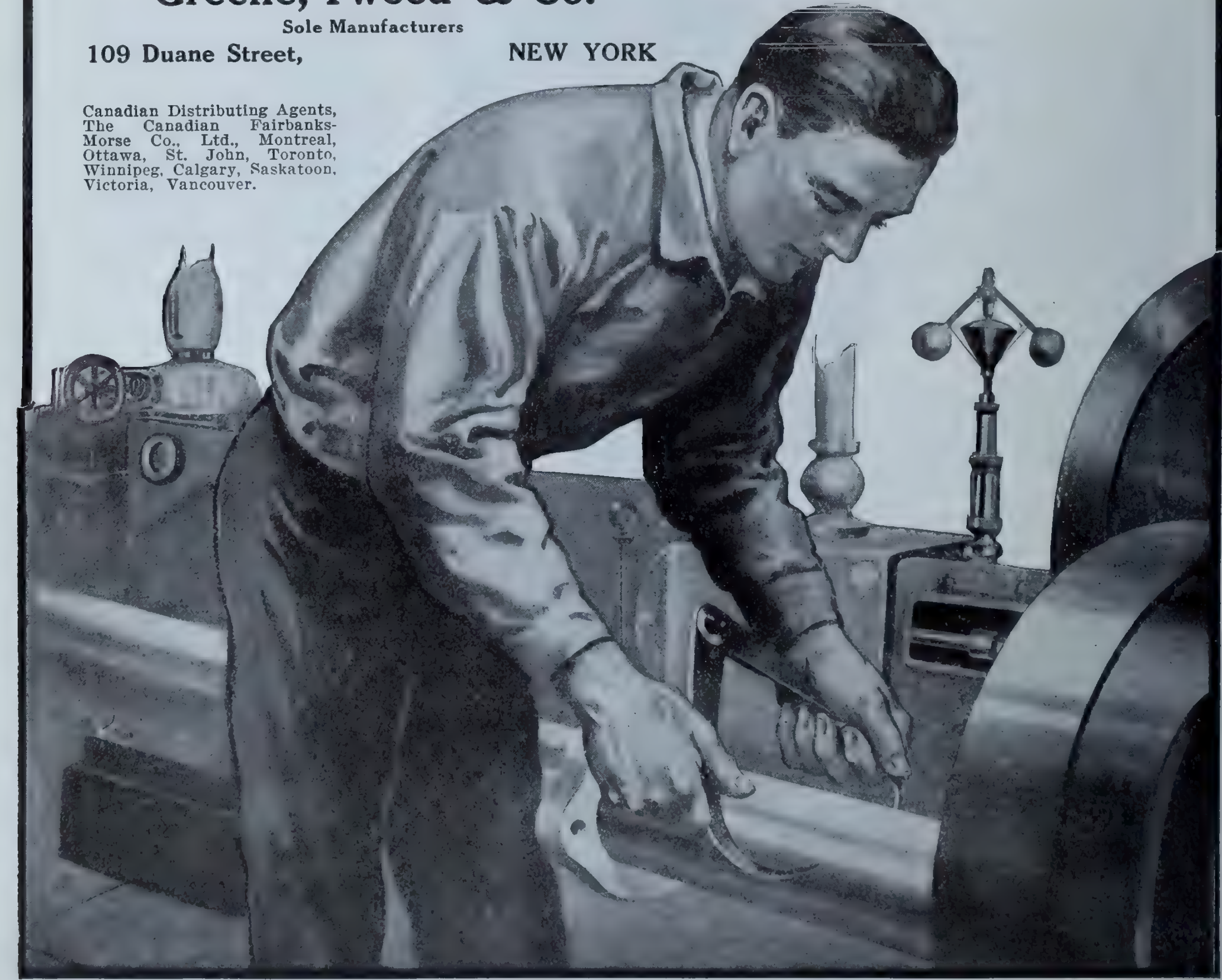

Don't Let This Happen To You

The menace of an "overdose" of ammonia fumes is too well realized to need emphasis—the important thing for you is to guard against any possibility of your becoming a victim.

Why take any chances so far as your AMMONIA rod packing is concerned when you can get

DANIEL'S ROD PACKING

P. P. P.

FOR AMMONIA PURPOSES

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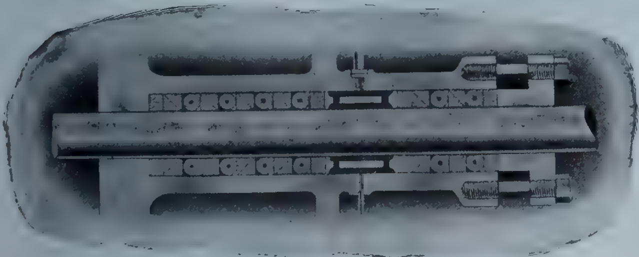
P. P. P. for AMMONIA uses is specially prepared. Don't use your engine rod kind.



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Kind of Rod Packing Used ....

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No matter what kind of a plant you operate

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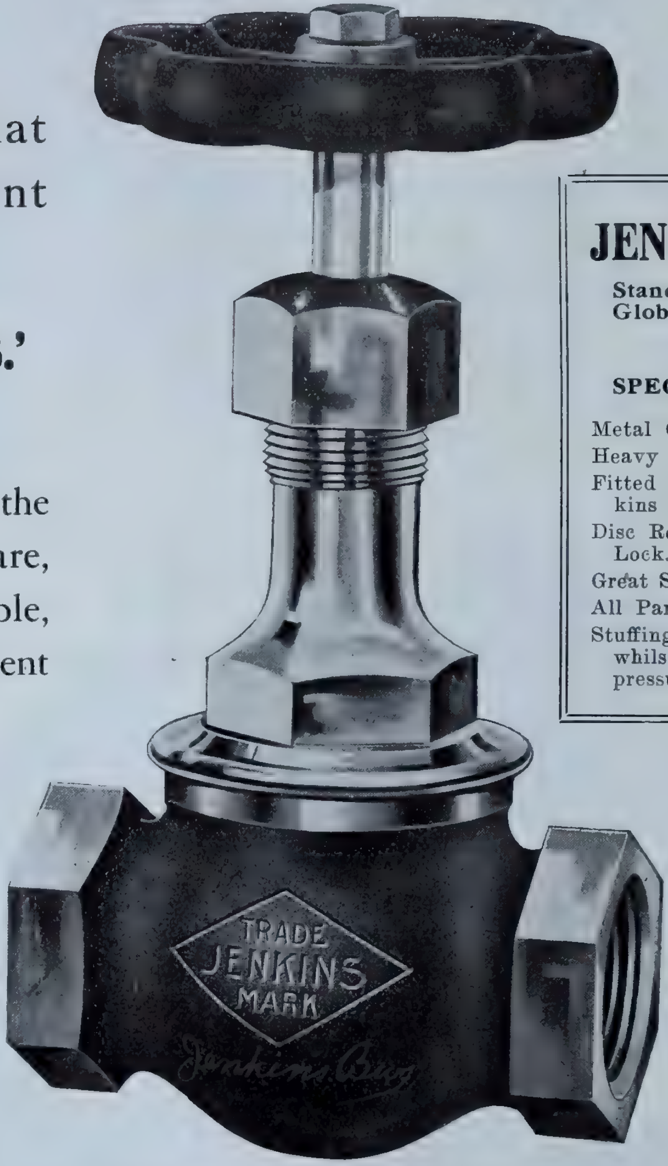
Standard Pattern Brass Globe Valves, Screwed

SPECIAL FEATURES:

Metal Gland in Stuffing-Box.
Heavy Thread on Spindle.
Fitted with Renewable "Jenkins Disc."
Disc Removing Nut and Nut-Lock.
Great Strength of all Parts.
All Parts Interchangeable.
Stuffing-Box can be Repacked whilst Valve is under full pressure and wide open.

Approved for use by the Depts. of Public Works in Ontario and the Western Provinces.



BRASS GLOBE VALVE
SCREWED
STANDARD PATTERN
Fig. 106

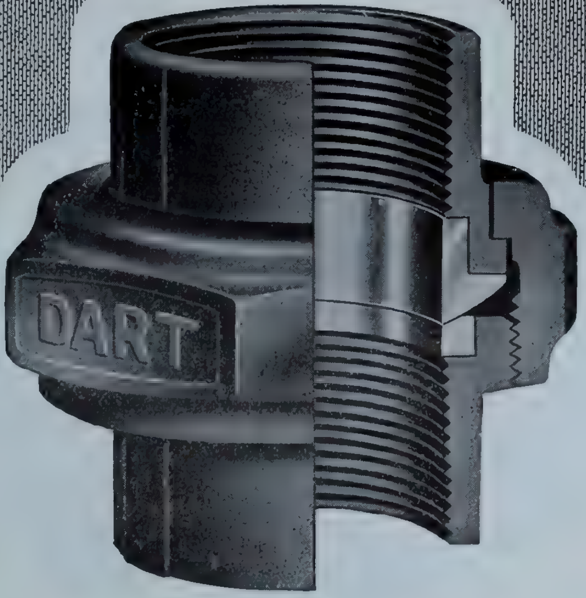
Order Them To-day.

Catalogue sent free upon request.

JENKINS BROS. Limited

103 St. Remi Street **MONTREAL**

DART Unions



Have a BRONZE to BRONZE Ball-Shaped Joint

Which permits connections to be easily and quickly made whether pipes are in or out of line.

The joint cannot rust or corrode and will never leak unless deliberately loosened with a wrench.

The heavy iron parts insure durability and long service.

They do not expand or contract.

A Dart Union requires no attention when in service. It never needs to be replaced.

Every Dart Union has our trade-mark cast on it. We replace two for one if a Dart is defective.

Get Them From Your Jobber

REDUCES EXPENSE

Dart Union Co., Limited
Toronto

EASILY CONNECTED

When You Order

HIGH PRESSURE JOINTING

Specify

GARLOCK HOLDTITE

Because,

"Holdtite" will stand a varying temperature up to 572° Fahr. Has a tensile strength of 3 tons per square inch and stands a comprehensive strain of 14 tons and still retains it elasticity.

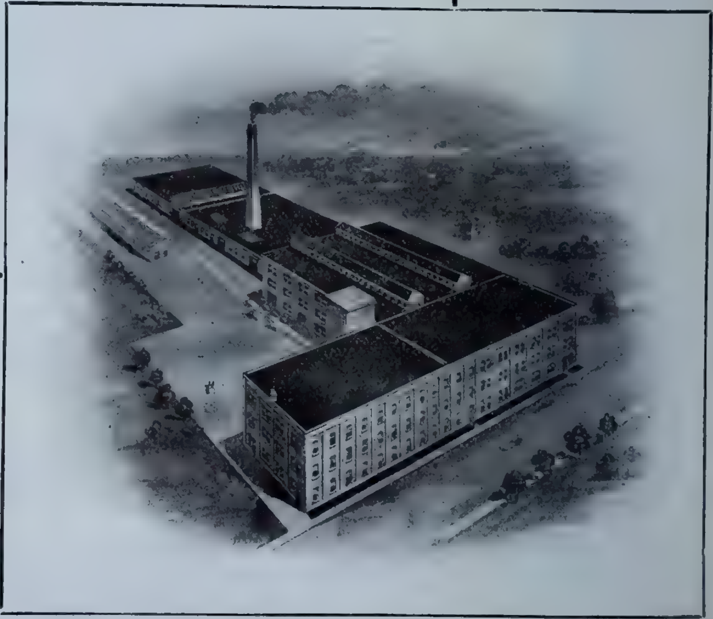
Put up in Sheets 40-in. x 40-in. in 1-32-in., 1-16-in., 1-8-in.

Write for sample and interesting information.

THE GARLOCK PACKING CO.
HAMILTON, ONT.

Montreal Toronto Winnipeg Calgary

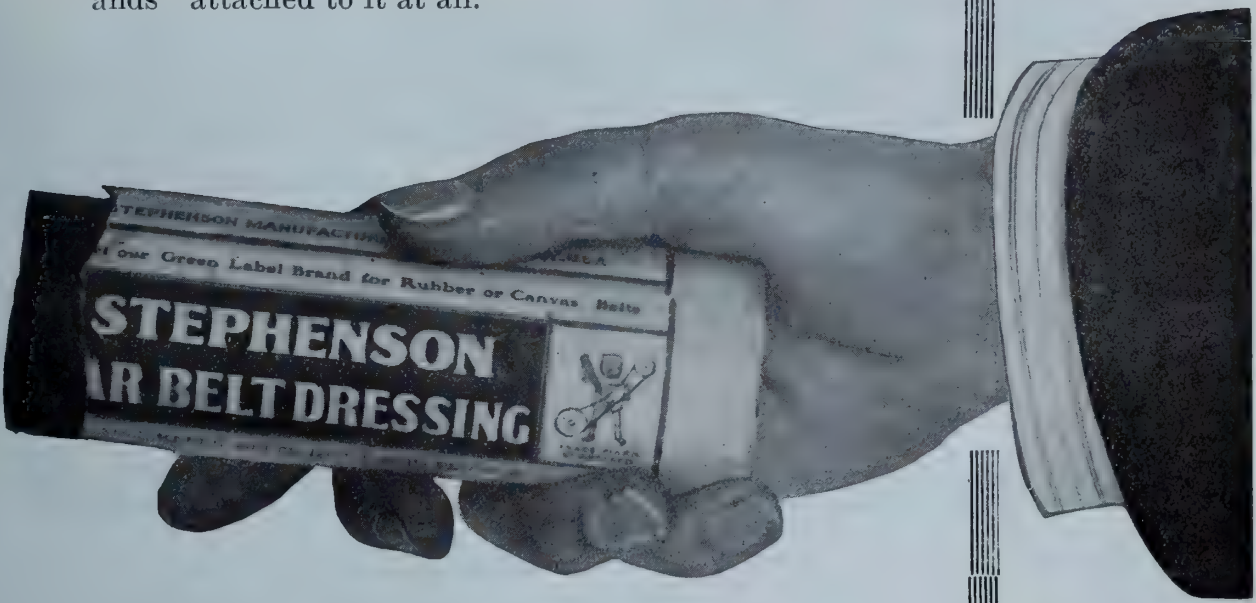
"Pioneers in the Packing Business — and Specialists"



Works at Hamilton

We'll send this 1/2 lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.

Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.

Gentlemen: Kindly send me free of charge a half-pound sample of your belt dressing.

Name ....

Firm ....

Address ....

G&K 1851
TRADE MARK

Educational Talks on Leather Belting.

Progress Made in the Manufacture of Leather Belting

In the construction of leather belts in the early days of the industry, the whole hide was cut into strips which were riveted together, so that the one grade of belting produced was made from leather that varied in quality, thickness and weight. This belting for several years answered all purposes for which belting was used.

The development of modern efficient machinery necessitated the manufacture of higher grade belting to meet the increasingly severe requirements.

Careful study in work-shop, testing-room and laboratory has resulted in the selection of hides, and the adaptation of processes and materials to produce several brands, or weights of high quality belting each peculiarly suited to certain conditions of service.

The rigid maintenance of this exact standard of quality, weight and thickness for each brand, in contrast to the old-fashioned methods mentioned above, is of vital importance, as it assures under similar conditions uniform service from any given brand of belting.

The improvement in leather for belting would have availed little had we not at the same time perfected a cement for joining laps, the use of which has superseded the old-style weak-riveted joint, and proven in actual service the strongest and most efficient method of constructing belts.

To determine the most efficient and economical quality, weight and thickness of leather belting for any particular drive it is essential to know:

First:—Whether for a horizontal drive or vertical drive.

Second:—Open drive, drive with idler, or quarter-turn drive.

Third:—Diameter of pulleys.

Fourth:—Revolutions per minute of driving pulley.

Fifth:—Horsepower to be transmitted.

Oak Tanned Leather Belting, as it has been developed, is recognized as the best belting for ordinary conditions. For certain unusual and exacting demands, however, we make a belt—our SPARTAN BRAND—using specially tanned leather and special cement—a belt remarkable for its pliability and, consequently, increased pulley grip, great tensile strength and resistance to steam, water, oil, heat and chemical fumes.

A comparison of the crude leather belting of early days, with our remarkably efficient modern product, will prove that our industry is well abreast of the day in mechanical progress.

Subject for next month : "Proper Selection of Belts."

THE GRATON & KNIGHT MANUFACTURING CO.

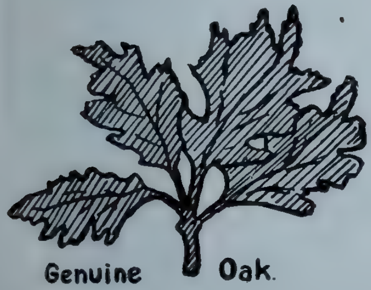
Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory : Worcester, Mass., U.S.A.

"Consult our Engineering Department in connection with your Transmission Problems "

Cost Cutting Service!


Genuine Oak.

On comparing the cost of upkeep and the life of

D. K. McLaren's Genuine British Oak-Tanned Leather Belting

with those of another make one always finds that D. K. McLaren's Belting requires less attention, and gives a service that is exceptional.

We employ experts to select hides, so that we use none but the very best.

Our Genuine British Oak Tanning process gives leather maximum strength, and makes it tough and pliable.

The cling means the delivery of maximum power.

We stretch our belting thoroughly before it leaves our Plant. Users don't have the bother of continually taking in slack.

Want to hear what users have to say? Then send coupon to our nearest office.

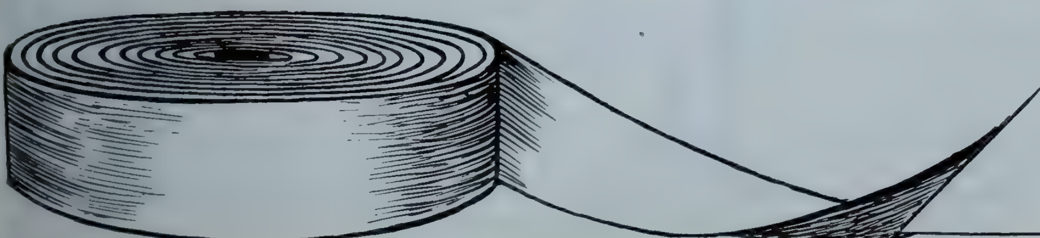
D. K. McLaren Limited

Montreal
351 St. James St.

Toronto
200 King St. W.

Vancouver
847 Beatty St.

St. John, N.B.
64 Prince William St.



D. K. McLAREN, Limited,
Gentlemen,—Please put me in touch
with some users of your belting.
Name ....
Address ....
Firm ....

Engineers all over the world like Cling-Surface.

Here is an example from Africa.

That Cling-Surface meets with universal approval from the tropics to the Arctics is proven by its use in foreign government service and by engineers wherever belt troubles exist. In moist tropical climates especially, where atmospheric conditions cause belts to change their length almost hourly, Cling-Surface makes fast and life-long friends. Mr. H. Jordan, a Consulting Engineer of Lorenzo Marquez, East Africa, writes us as follows:

"I have had 5 years' experience with Cling-Surface here and have recommended it with success.

"I first tried Cling-Surface on wood-working machinery, having 48 in. saws, running on 14 in. pulleys driven from 36 in. pulley on the countershaft on 20 ft. centres. I gave the belts 10 in. slack to start and had them kept clean. On account of the saw-dust I feared the slack would be too much, but they run splendidly and appear little worse for five years' wear.

"Am using a 50 h.p. gas engine driving ice-making and mining machinery. The engine pulley is 36 in., the line shaft pulley 60 in., centre distance 18 ft., and the 8 in. balata belt treated with Cling-Surface has 18 in. slack, but no slip. 26 belts on this line, ranging from 2 to 6 in., including three compressor drives, are also treated with Cling-Surface."

Operators of woodworking machinery know how difficult it is to keep the belts free from sawdust and shavings. A sticky preparation here would only make matters worse. Mr. Jordan appreciated that and used Cling-Surface because it acts from the inside of the belt to impart pliability and gripping power.

True belt economy demands Cling-Surface and the sooner you make the trial, the sooner you will realize the truth of all our claims. The cost of a trial package of Cling-Surface is insignificant in comparison with the benefits and it costs nothing unless you are satisfied. We quote f.o.b. Toronto.

Ask for literature.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo N Y

I am interested in Cling-Surface and your trial order proposition.

Name .... **Position** ....
Firm ....
Street ....
City .... **State** ....

59

A Simple Twist Tightens Any Rope

No. 95126
Hunt Tension Adjusting Coupling spliced in the rope ready to put on the drive

If one of the bands on your multiple rope drive stretches, do you resort to the old-fashioned method of cutting out a piece of rope and resplicing it?

No. 0835.
1000-H.P. Rope Drive equipped with Hunt Tension Coupling Bands.

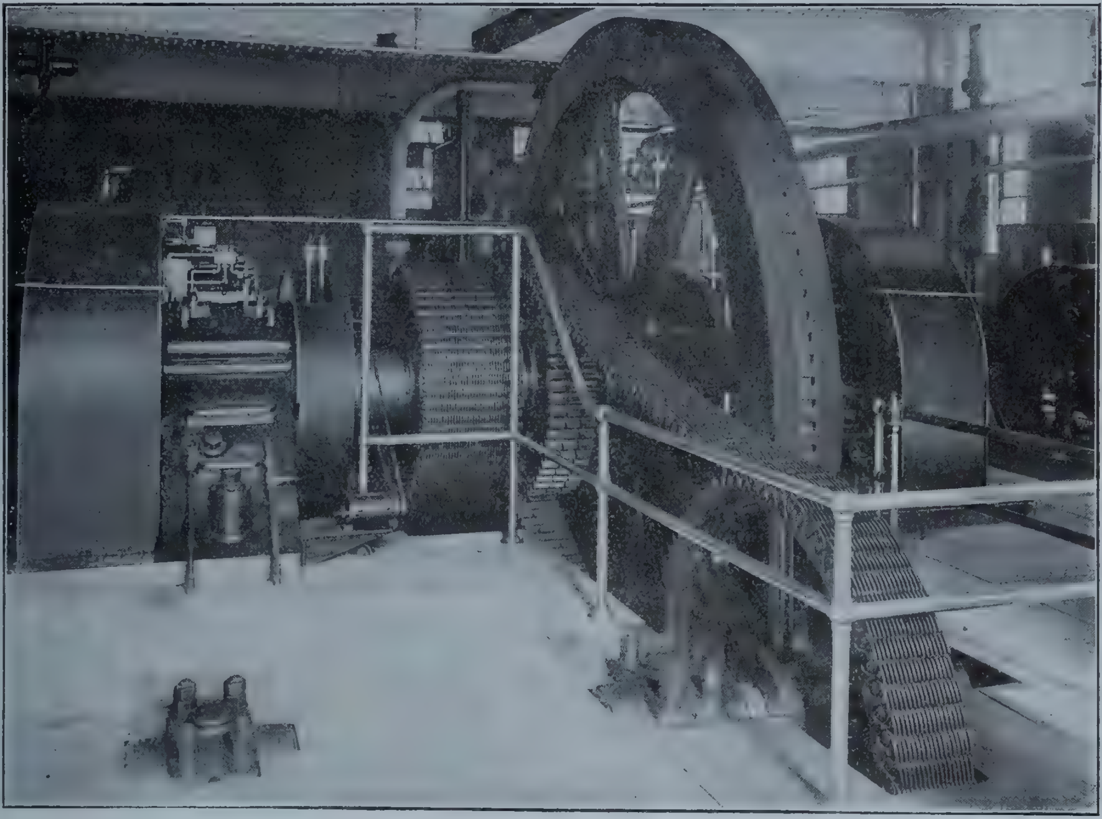
All this is unnecessary if your drive is equipped with Hunt Tension Adjusting Coupling. A simple twist of the coupling tightens up any individual band and makes each rope do its share of the work.

If interested in learning more about these couplings and Hunt Stevedore Rope, with its unique system of internal lubrication that prevents wear and increases its efficiency, ask for a copy of our catalogue J 12.8 "Manila Rope." It contains 50 pages of information on rope drives for engineers.

C. W. HUNT CO., Inc.

West New Brighton, N.Y., U.S.A.

Fisher Bldg., Chicago. Evans Bldg., Washington.
45 Broadway, New York City



At Indianapolis

THE above illustration shows an application of MORSE Silent Chains, which for compactness, reliability, efficiency and size is particularly interesting to all users of power in large units.

Read the complete details, to wit:—

1,000 Horsepower, 95 to 70 R.P.M. on 103.24″ centres. Sprockets, 61 and 83 teeth. Chain, 3″ pitch, 24″ wide. Speed, 1,450 feet per minute.

500 Horsepower, 95 to 75 R.P.M. on 135.32″ centres. Sprockets, 61 and 77 teeth. Chain, 3″ pitch, 12″ wide. Speed 1,450 feet per minute.

These chains were installed in March, 1910, for driving line shafts from engine in an Indianapolis Rubber Mill. To the best of our knowledge, neither drive has required any repairs.

Why not "Chain Your Engines Down to Duty" like this? It will pay you in power saving and increased production right from the start. Write for details, prices, and copy of Publication No. 12.

Morse Chain Company, Ithaca, N.Y. B-17 R

Since you admit that some filtering system is better than none — why not get the one that filters best?

YOU have already learned that *any* filtering system will save money and increase lubricating efficiency over none. Now consider the *most efficient* Clarifying Device.

Gravity takes out all heavier and coarser impurities, *then* each gallon of oil per hour is forced through *three square feet* of very fine filtering cloth. What impurity, what atom of grit could remain in oil so filtered? The Bowser System insures stream feed to every point to be lubricated. It returns impure oil to the filters and clarifies it. The oil is used over and over.

BOWSER
ESTABLISHED 1885

The System With Three Sq. Feet of Filtering Surface for Each Gallon of Oil

A Bowser Filter Section Extended

We broadly claim that the BOWSER SYSTEM offers the *most efficient* filtration, either as a Central Oil Clarifying System or an Individual Unit.

Surely it is worth while to investigate and learn how many are in daily use. Send the coupon for the free Bowser Book—NOW. Absolutely no obligation incurred by the request.

S. F. Bowser & Co., Inc.
32-74 Frazer Avenue
Toronto, Ontario, Canada
Engineers and Manufacturers of Oil Handling Devices
Sales Offices in all Centers and Representatives Everywhere

COUPON

S. F. BOWSER & CO., Inc., 32-74 Frazer Ave., Toronto, Ontario, Canada.

Without expense or obligation on my part send me the particulars regarding a Bowser Oil Storage Outfit for the purpose indicated with an [X]

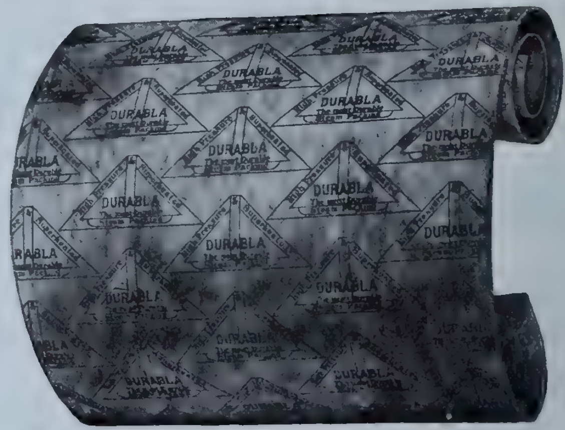
[ ] Private Garage [ ] Power Plant *[ ] Manufacturing
[ ] Public Garage [ ] Dry Cleaners †[ ] Stores

*STATE WHAT YOU MANUFACTURE †OR SELL

Name ______

Street No.______ Town______ State______

DURABLA



Registered Trademark Stamped all Over the Sheet

SHEET PACKING

Increases efficiency; lessens amount of materials used
Never Fails!

Canadian Sales Agents
CANADIAN FAIRBANKS-MORSE CO., Limited
Montreal, Ottawa, Calgary, St. John, Toronto
Saskatoon, Quebec, Winnipeg, Vancouver.
Manufactured by
DURABLA MANUFACTURING CO. NEW YORK

Canada's Departmental House for Mechanical Goods

Upper run of Jeffrey Pivoted Bucket Conveyer handling fifty tons coal per hour.

JEFFREY
Coal and Ashes Handling
MACHINERY

is a paying proposition in any Power Plant.

Our *STANDARD* Equipments can be applied to all types and sizes of Power Plants.

Bulletin No. 32-B pictures some interesting installations. Send for copy.

JEFFREY MANUFACTURING COMPANY
Canadian Main Office and Works, MONTREAL

"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

"AMERICAN"

STEEL SPLIT PULLEYS

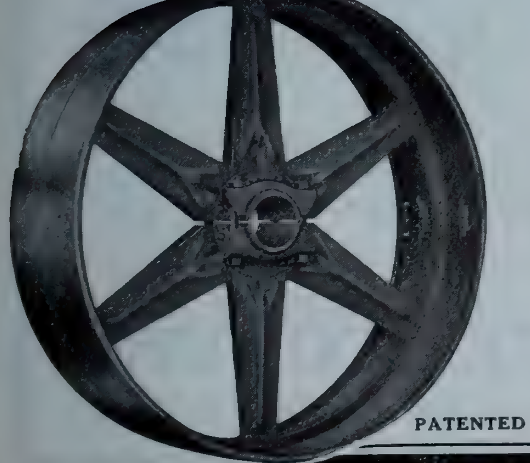
Excel In:

- Ease Of Application.
- Method Of Securing Arms To Rim.
- Safety To Belt.
- Grove In Face For Air Escape.
- Method Of Crowning.
- Saving In Air Fanned.
- Maximum Strength With Saving Of Dead Weight On Shaft.

These are most vital considerations in securing better power transmission and the importance of getting the pulley that excels in these points cannot be overestimated.

Information, concerning above and other American Pulley superiorities, is found in "Factors of Energy," a booklet containing facts and figures every pulley user should have.

"American" Steel Split Pulleys are made in diameters 3 to 60 inches inclusive. Pulleys above 60" diameter on application.



PATENTED

The American Pulley Company

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers:

Canadian Dealers: Williams & Wilson, Limited, Montreal, Que. A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N.B.; Winnipeg, Man.; Calgary, Alta.; Vancouver, B.C.

DEALERS EVERYWHERE

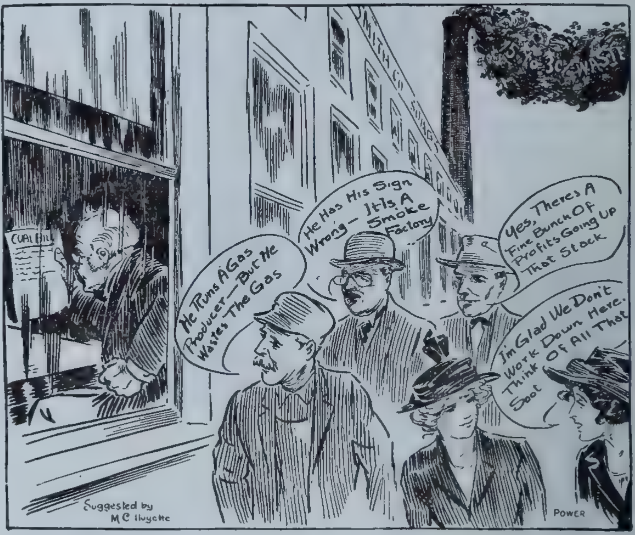
SMOKE MEANS WASTE

Apparent to all but the one most concerned

This cartoon—by "Power"—is self-explanatory; it is a showing of a "Manager" kicking about "Coal Bill" and ignoring the wasteful condition of boiler-plant equipment.

Smoke is a sure indication of waste of heat—money—value of coal fuel.

Determine 20 per cent. of your annual coal bill, and you will approximate the dividend-earning power of money investment required for **Murphy Automatic Smokeless Furnaces.**


15% To 30% WASTE
SMITH CO
COAL BILL
He Runs A Gas Producer—But He Wastes The Gas
He Has His Sign Wrong—It's A Smoke Factory
Yes, There's A Fine Bunch Of Profits Going Up That Stack
I'm Glad We Don't Work Down Here. Think Of All That Soot
Suggested by M C Huyette
POWER

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

Smoke Elimination Is Profitable

"A smoky chimney **does** mean a busy plant, but a smokeless chimney means one **just as busy,** with 12 to 15% higher efficiency from the coal used."

In hundreds of cases Jones Stokers have eliminated smoke and at the same time have so raised the efficiency of the boiler plant that a 15 to 25% saving has been effected.

Jones Underfeed Stokers are playing a leading part in the great smoke abatement crusade which is sweeping the Country—**and are paying a good big dividend to their purchasers** as well.

They will save money in your plant, too.

JONES UNDERFEED STOKER CO., LTD.

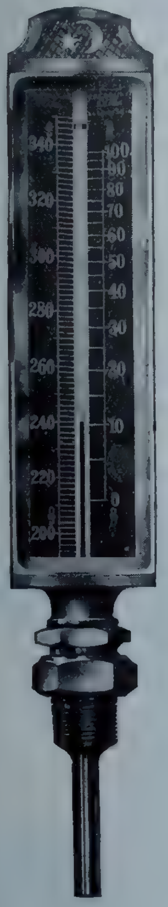
National Trust Building **TORONTO**

Accurate - Reliable

Always

THAT'S why "Crescent" Thermometers are used so extensively in Canadian Power Plants.

For consider — embodied in every "Crescent" Thermometer is the accumulated **knowledge** and **experience** of over 60 years of Thermometer-making. This is your **assurance** of the very highest degree of mechanical perfection. Best quality of material and extreme accuracy are a matter of course. And as for appearance — a more handsome instrument could not be desired.



"Crescent" Thermometers

are furnished in nearly 100 different styles and types. There is a complete line for all Power Plant requirements.

Our Catalog

WE have a complete catalog of instruments for Power Plants—interesting and instructive and well worth the having. A postcard request will bring it to you. Just say—"Send me Catalog W. 27."

The Schaeffer & Budenberg Mfg. Co.

BROOKLYN, N. Y.

Chicago **Pittsburgh**

Cuts Easier the Longer It Cuts.

PIPE-THREADING isn't easy, but it's been made easier by the coming of the Matchless. It's not only **easy** cutting—but it **cuts easier the longer it cuts.** Here are some of the interesting features that make the Matchless one of the most popular of

OSTER TOOLS

The Dies (one set for all sizes) are **narrow**, and **recede** as the thread is cut. This reduces labor to the **minimum**. The Dies are double taper—the first teeth do the roughing, the others the finishing. This results in **smooth, accurate** threads.

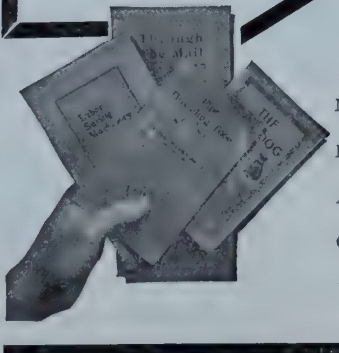
Varying the size of the dies to suit any fitting is easy. It is done by cam control and a simple setting device, requiring just one setting for each size. **Duplicate threads are made without resetting dies.**

Patented Chip Shield makes the Matchless practically indestructible. The shield protects the leader screw so perfectly that it's impossible for chips to get into the threads and injure the teeth. The coupon will bring you some interesting reading by return mail. Use it now.

WRITE TO-DAY FOR THESE FREE BOOKS.

The Oster Mfg Co.
2099 E. 61st St.
CLEVELAND, OHIO

Kindly send by return mail "The Bulldog Tale," "Labor-Saving Machinery," "Through The Mail" and "List 28."



Name ....

Business ....

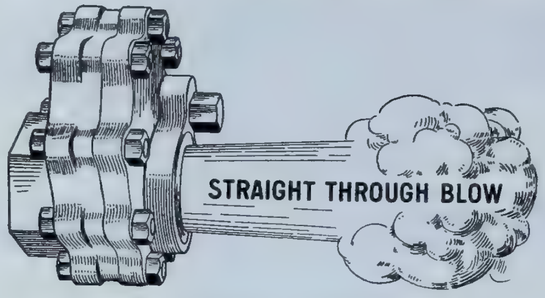
Address ....

City ....

Province .... ☐

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!

WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

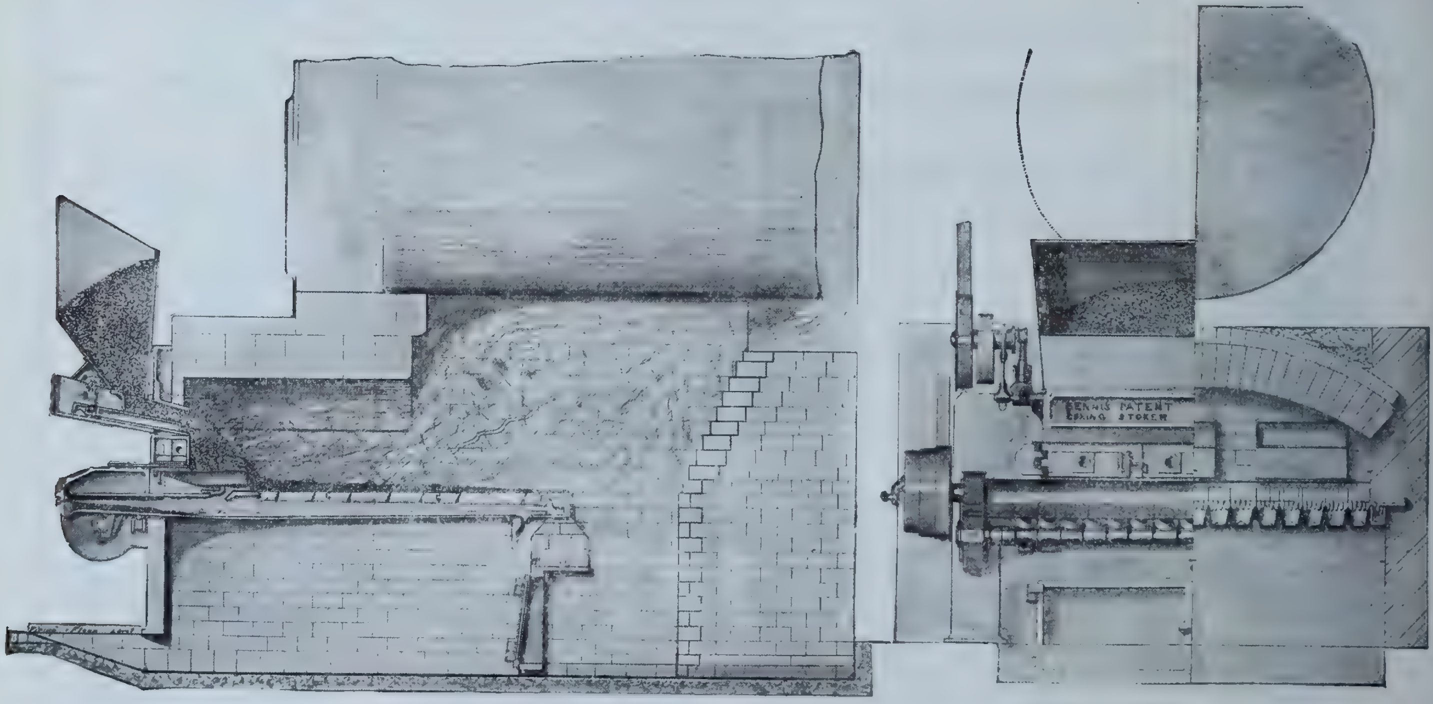
SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiller & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.



LONGITUDINAL SECTION

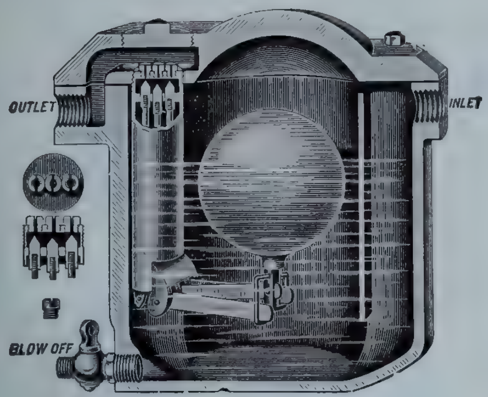
FRONT VIEW

ARRANGEMENT OF BENNIS COKING STOKER APPLIED TO HORIZONTAL RETURN TUBE BOILER

MILLIONS OF DOLLARS are SAVED YEARLY by the USE of BENNIS MACHINE STOKERS

WRITE FOR A FULL SET OF "BOILER HOUSE ECONOMY AND CHEAP STEAM" PAMPHLETS TO

G. H. TOD,
213 Manning Chambers, Queen St. West,
Winnipeg: 601 Union Bank Building
TORONTO



Wright
"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

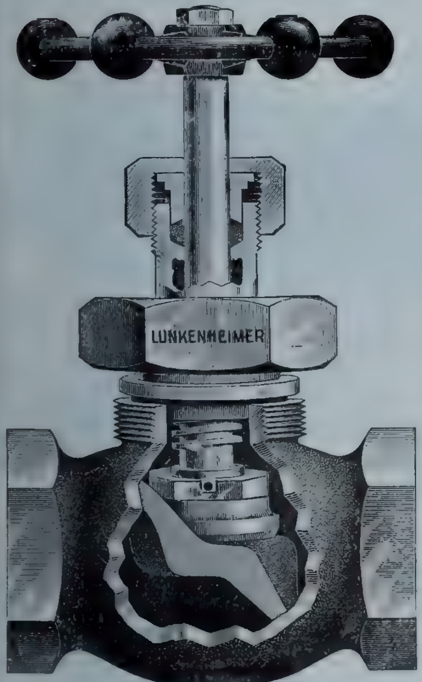
Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited

15 Ottawa Street, MONTREAL

TORONTO WINNIPEG ST. JOHN, N.B.



LUNKENHEIMER Regrinding Valves

"The Valves That Last And Satisfy"

Seating surfaces regrindable.
All parts renewable
Material used—a high-grade bronze composition formulated in our own laboratories.
Made only by skilled workmen.
Passage through bodies free and unobstructed
Stuffing-boxes can be repacked under pressure.
Thoroughly tested and carefully inspected before leaving the factory.
Made in two weights—Medium for steam working pressures up to 200 pounds and Extra Heavy up to 300 pounds per square inch—sizes ⅛ to 4 inches.
Guaranteed to be exactly as represented.
Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.
Your local dealer can furnish them; if not, write us. Write for Catalogue.

THE LUNKENHEIMER CO. 3-43A

"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World.

Executive Offices and Factories: CINCINNATI, OHIO, U. S. A.

New York, 64-68 Fulton St.
Chicago, 188 N. Dearborn St.
Boston, 138 High St.
London, S. E., 35 Great Dover St.

FOSTER VALVES

There are many types of "Foster" valves for wide and diversified service—all make for economy—some, in addition, assure safety. In buying a valve that is not certain, not sure in the performance of its functions, you run big chances of making experience unnecessarily expensive, if not worse.

The Strongest Feature in all Foster Valves is Reliability

Pressure Regulators—For maintaining a constant terminal pressure of steam, water, gas or air. Class "W"—constant service. Class "G"—intermittent service. Classes "Q" and "QH" — for steam-heating systems 1 to 15 lbs delivery. Adopted as "standard" by some well-known engineers. Class "U"—for water (or air) service.

These are only a few of the fifty different types of Foster Valves. Use Durabla Packing for all flanged joints.

The Canadian Fairbanks-Morse Co.
Limited

Montreal, St. John, Toronto, Ottawa, Hamilton, Winnipeg, Calgary, Vancouver, Victoria.

Canada's Departmental House for Mechanical Goods

MARSH and AMERICAN Pumping Machinery For Every Service

MARSH VACUUM PUMP.

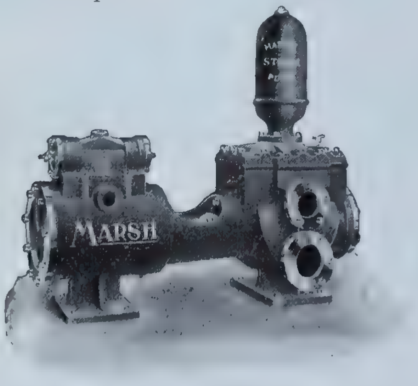
Marsh and American Pumps have a reputation for extreme simplicity combined with the highest efficiency. They are built for long continuous service and may be relied upon to do their work continuously, even under the most severe conditions. They cannot short-stroke, race or pound.

A Complete Line of

Boiler Feed Pumps,	**Deep Well Engines,**
Vacuum Pumps,	**Air Compressors,**
Power Pumps,	**Tank Pumps.**

Our slogan: Simplex, not Duplex. "To be simple is to be great."

Ask for Bulletins.

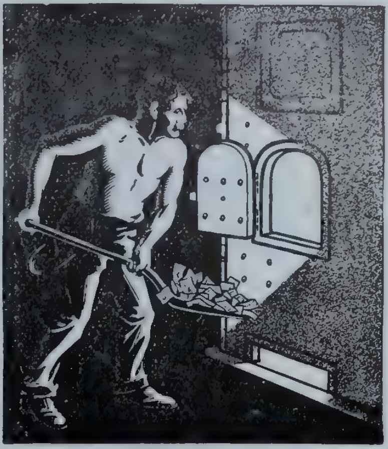


MARSH BOILER FEED PUMP.

AMERICAN STEAM PUMP CO.
BATTLE CREEK, MICH.

CANADIAN AGENTS:
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman Machinery Co., Vancouver, B.C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited, Edmonton and Calgary.

How Much Money Are You Wasting to Overcome Piston-Rod Friction?

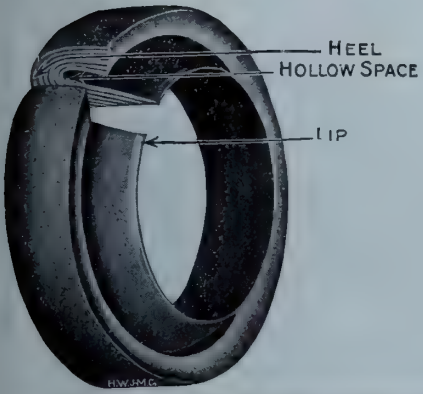


To operate the average simple high-speed 50-H. P. engine requires about 1500 lbs. of steam per hour, or 4,500,000 lbs. in a 300-day year of ten working hours a day.

As one pound of coal makes about 8 lbs. of steam, this means 280 tons of coal a year—a total annual fuel cost of $840.00 with coal at $3 per ton.

When the stuffing box of such an engine is packed with ordinary soft packing at least 5% of this power, or $42 in actual money, is wasted in overcoming rod friction! You can save at least 75% of this waste, or $31.50 in fuel, by packing your piston rods with

J-M SEA RINGS



The operation of these rings is entirely automatic. They are so constructed that their pressure against the rod is always in exact proportion to the pressure exerted on them by the steam or contents of the cylinder. In every ring there is a hollow space between the "lip" and the "heel" (see illustration) into which the steam or other gas or fluid flows, forcing the "lip" against the rod with just sufficient pressure to prevent leakage past the packing. When there is no pressure on J-M Sea Rings they do not press against the rod.

J-M Sea Rings eliminate unnecessary wear on themselves and on the rod. Therefore, they outwear ordinary rod packings.

Many other advantages of J-M Sea Rings are clearly and concisely described in our illustrated "Blue Book." Write nearest Branch to-day for a copy.

THE CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Boiler Preservative; Conduit; Metallic Hose; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners; etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

1884

KERR

(New "KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.

District of Montreal

Our Specialties are Built under Experienced Supervision

Try us when in the market for

Oil Switches, Disconnecting Switches, Switchboards, etc., etc.

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NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

THE UNBREAKABLE KIND

Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN JR. COMPANY

23-25 Dowd Street MONTREAL

Live Agents wanted all over Canada.

Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Toronto **MONTREAL** **Winnipeg**

Fourth of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s Limited, wires.

This picture shows the

ELECTRIC RAILWAY CHAMBERS, Winnipeg

This building was wired with "Imperial Higrade" Rubber Insulated Wire.

Architects - - - - - - Pratt & Ross, Winnipeg.
Engineers - - - - - - Neiler, Rich Co., Chicago.
Electrical Contractors - Schumacher Gray Co., Winnipeg.

Address enquiries to nearest office

Northern Electric Company

LIMITED

Montreal	**Winnipeg**	**Edmonton**
Halifax	**Regina**	**Vancouver**
Toronto	**Calgary**	**Victoria**

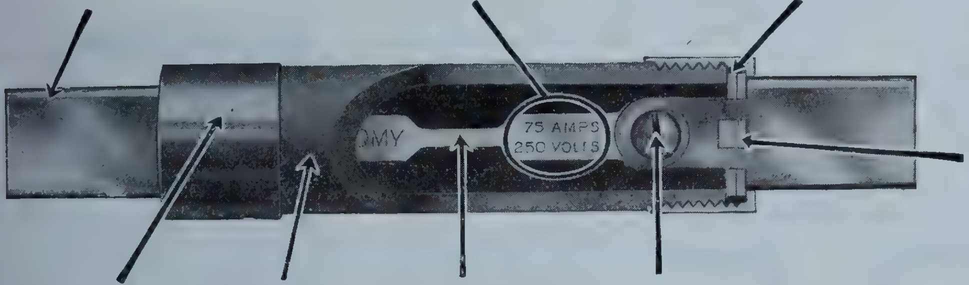
Successors to
Imperial Wire and Cable Co., Limited.

Correspondence previously addressed to the Imperial Wire & Cable Co., Limited, at 611 C.P.R. Building, Toronto, and 902 Electric Railway Chambers, Winnipeg, should now be addressed to Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave. West, Winnipeg.

Round edge hard drawn copper.

Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.

This venting feature allows no fire to escape, even on severe short circuits.



Washer assembly centres, locks in position and aligns blades.

Heavy solid brass cap.

Unusually heavy gray horn fiber shell.

Short, active length of element assures uniform performance.

Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

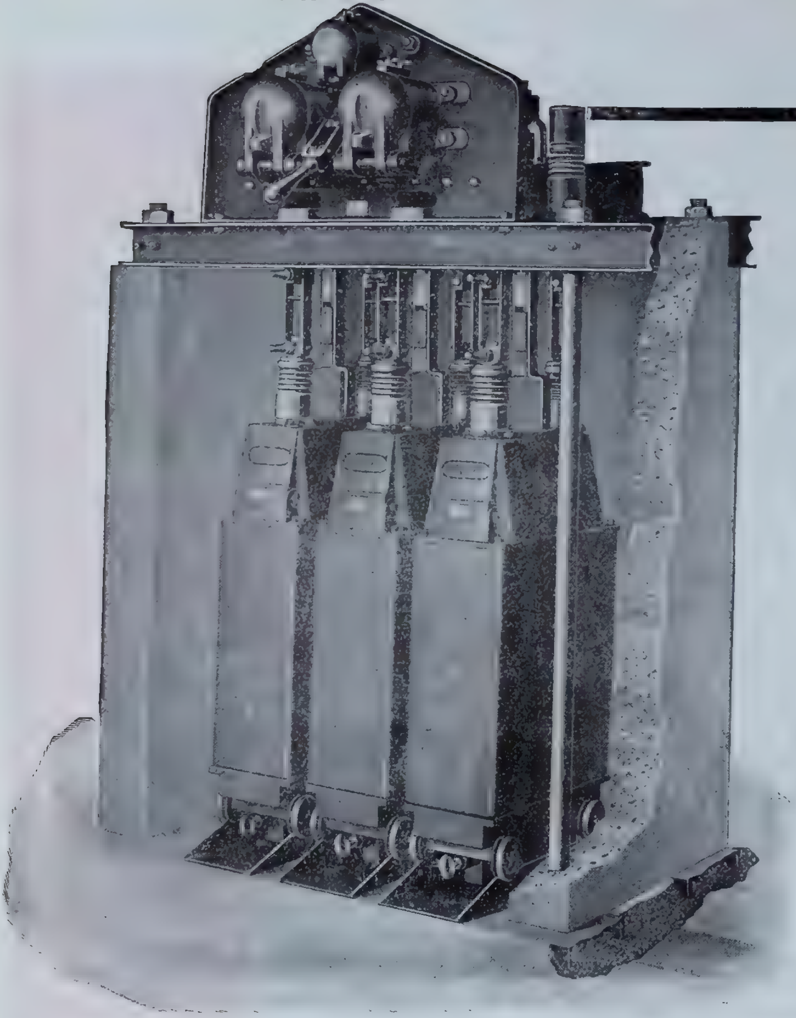
Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.



CONDIT

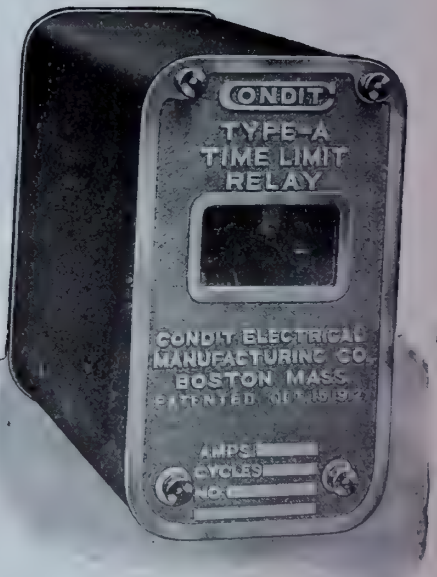
Reliability—Continuity of Service

Selective Operation

There is no requirement for protective devices that CONDIT equipment cannot meet.

Let the Technical Specialists at our nearest house go over your requirements with you.

Ask for Bulletins 404-405-406-407.



Northern Electric Company

LIMITED

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Reduction In Prices

On all Types of Sunbeam Incandescent Lamps

But the lamps are as rugged as ever.

Our new low prices came into effect—May 1st.

Why not write your nearest dealer to-day for them, or advise us of your yearly requirements?

Our yearly Contract proposition will interest you.

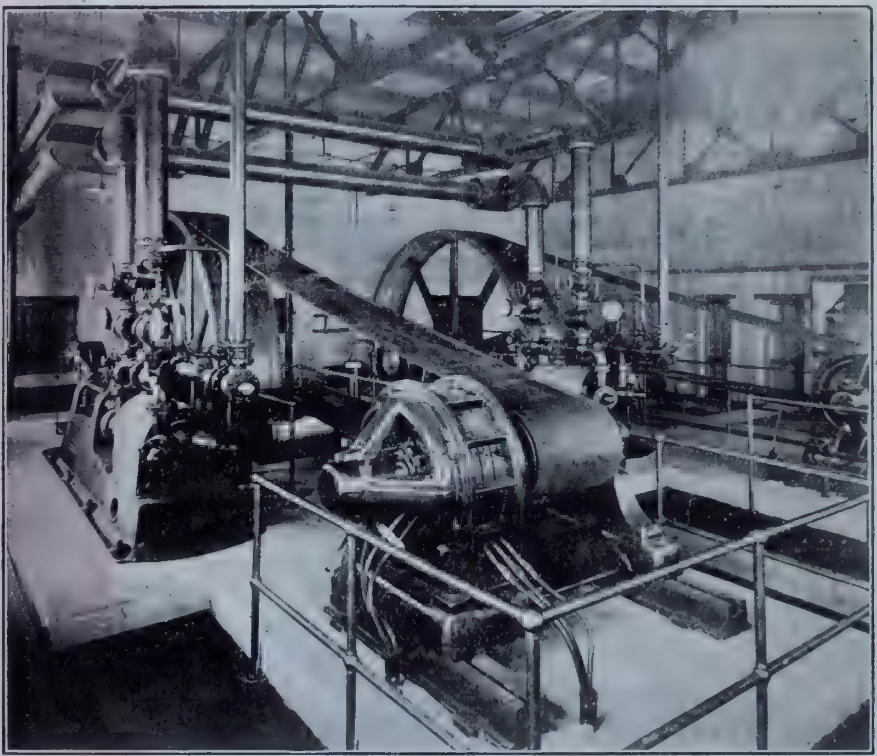
The Canadian Sunbeam Lamp Co., Limited
Main Office and Factory: TORONTO
Branch Warehouses:
MONTREAL, WINNIPEG, CALGARY, VANCOUVER

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogues and estimates upon request.

The Linde Canadian Refrigeration Co.,

Limited

37 ST. PETER STREET, MONTREAL

Branch Offices—Toronto, 23 Scott St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, Tegler Building; Calgary, 407 P. Burns Building.

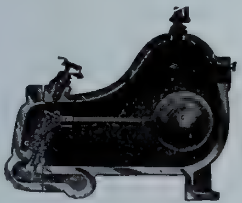
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.

EXCELSIOR

ANHYDROUS AMMONIA

EFFICIENCY
100%

PURE
GUARANTEED
DRY

CANADIAN
AMMONIA CO.,
LIMITED
TORONTO, ONTARIO

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

Bulletins sent on request.

The Vilter Mfg. Co.
242 Becher St. Milwaukee, Wis.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and many of our machines installed over twenty years ago are to-day maintaining their high initial performance.

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name De La Vergne stands for highest quality, maximum capacity, absolute reliability and permanent economy.

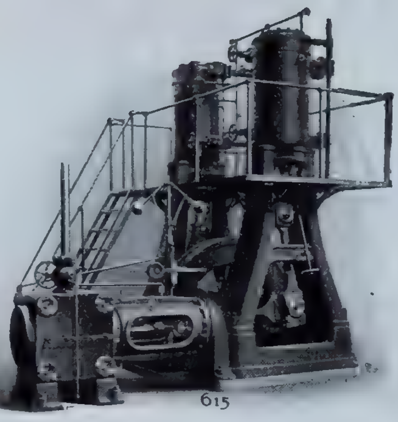
Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada

York Standard Vertical Single-Acting Machines



are the result of years of experience in building various types of Ice-Making and Refrigerating Machines.

Each Machine has built into it the best material, skill and practice at our command. It is the best Machine we know how to build. It is the Machine you ought to buy, because it can be relied upon in the rush season, when you want to crowd things a bit.

Here are some features of this Machine that should appeal to the discriminating buyer,—Wrought Steel Galleries; solid Cranks and Pins of Cast Steel; Nickel Steel Piston Rods and Wrist Pins; Cast Steel Engine Cross-head. All parts are made to jigs and templates, so that interchangeability and absolute fit of repair parts are assured. Design is simple and substantial. All parts are easy of access.

Built in various sizes from 20 to 600 tons refrigerating capacity, either belt or steam-driven, with simple or compound engines.

Write to-day for Bulletin No. 10a—just off the press—tells you all about YORK Standard Vertical Single-Acting Machines.

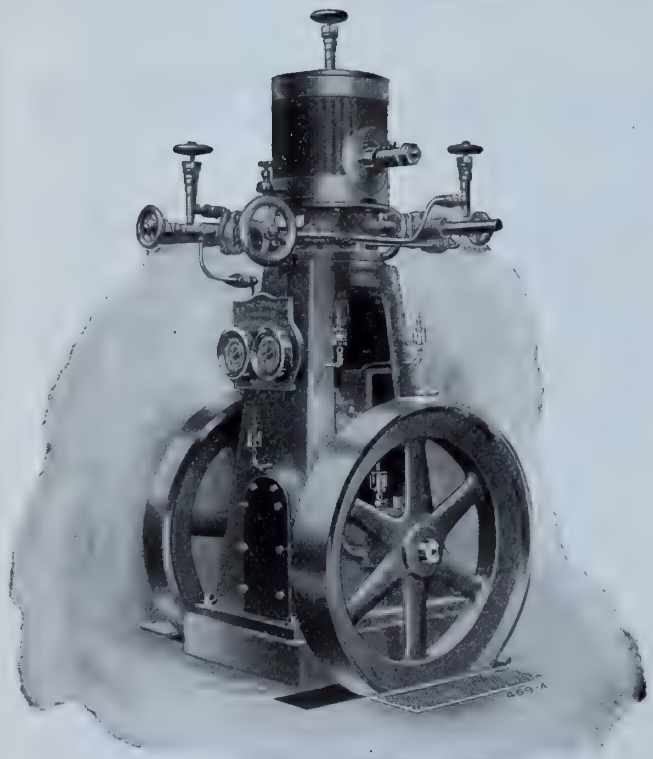
YORK MANUFACTURING COMPANY, YORK, Pa., U. S. A.

Ice-Making and Refrigerating Machinery Exclusively

Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

MONTREAL, 324 Coristine Bldg.
TORONTO, 163-167 Yonge Street
WINNIPEG, 302 Donalda Bldg.



A Refrigerating Machine

To remain at the top of the ladder of success

Must be very heavily built;

Must have large bearings so placed as to support the engine thrust at both sides;

Must have all wearing surfaces both adjustable and renewable;

Must have large Valve areas and safety relief on discharge;

Must have every part built for service and safety;

It is by having these features and keeping them that *THE FRICK* Remains there.

Canadian Representatives
Keith's Limited
297 Campbell Ave. Toronto

FRICK COMPANY
Waynesboro, Pa., U. S. A.

J. V. Jamison, President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

Change of Name

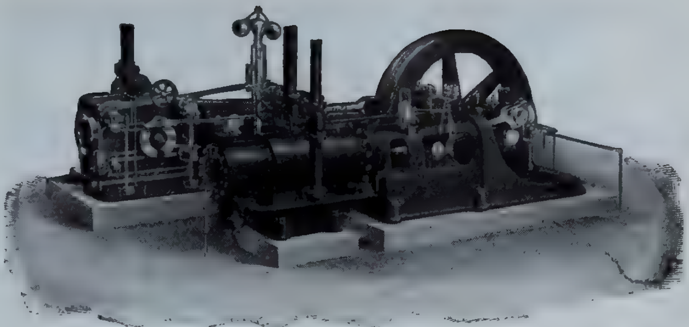
On and after September 1st, 1914

Jones Cold Store Door Co.

will change its corporate name and will thereafter be known as—

The Jamison Cold Storage Door Company
HAGERSTOWN, MARYLAND

No change whatever will be made in the organization or the business of the Company. The personnel of the management and the sales and shop force will be the same as it has been since 1907.



Arctic Ice Machines
in Canada

are creating sales wherever installed. Recently we placed in operation an Arctic Refrigerating Plant for the St. Regis Hotel, Winnipeg.

Next the St. Charles Hotel, Winnipeg, ordered a similar outfit.

We are now shipping an Arctic ice and refrigerating plant to the new Olympia Hotel, Winnipeg.

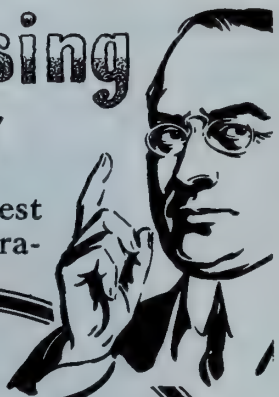
In ice factories, storage houses, etc., we can point to the same occurrence.

When an ice machine is its own best salesman—well, you want that kind.

Sizes from one-ton refrigeration upward.

Bulletin 1-P on request.

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.



You're Losing Money

If you are not using the best insulation in your refrigeration plant.

You Can Stop That Loss At Once By Using Our

Corkboard Insulation

It is made of pure cork, and is recognized as the best insulation for cold storage and refrigerating purposes.

It is the only cork insulation that is made in Canada.

Write for full particulars.

Robinson Bros. Cork Co.,
LIMITED
HEAD OFFICE—803 LUMSDEN BLDG. TORONTO
FACTORY—
PORT COLBORNE, ONTARIO

THE H&C SAFETY

SAFETY FIRST!-

Economy, Durability, Efficiency

ALWAYS

This is the whole secret of the

"H. & C. Safety" Success

The strongest single proof of the "H. & C. Safety" Compressor's ability to give you a profitable year in—year out service is the list of growing, successful concerns using the "H. & C." System.

Our repeat orders for additional equipment to supply the increasing demand of our old customers—customers who are already operating one or more "H. & C. Safety" machines and know their strength, simplicity and capacity is a big business in itself.

And it's business we are particularly proud of—this re-order business. Because it proves absolutely that the "H. & C. Safety" has given a big "value received" or we would never have gotten the invitation to do it again.

Write for our booklet on "Cold Facts."

THE HUETTEMAN & CRAMER COMPANY

Manufacturers of
Refrigerating and Ice-Making Machinery

DETROIT MICHIGAN

SIMPLEX SPECIALTIES

SIMPLEX PATENT VALVE RESEATER

Simplest Machine on Market.

All Sizes up to 15".

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Self-Centering Visible Cutters

A necessity in an up-to-date Power Plant.

Faces Valves with Flat or Angled Seats

SIMPLEX No. 2 SELF-ADJUSTING FLUE CLEANER

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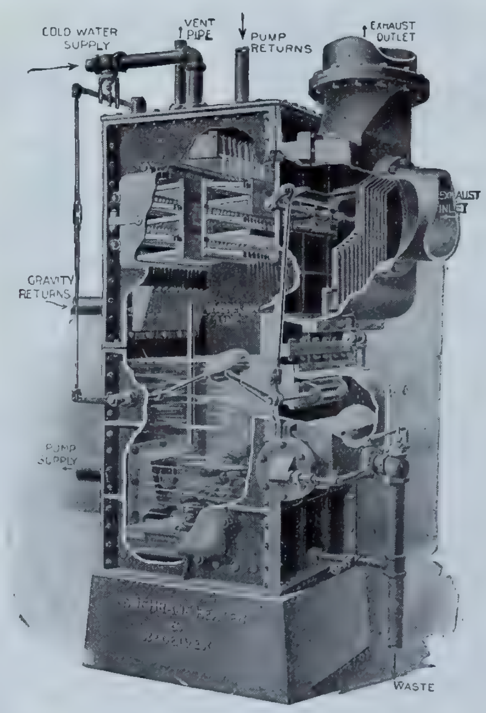

THE COCHRANE STEAM-STACK HEATER

The utilization of exhaust steam offers larger opportunities for increased economies than any other field in most plants. This is because 70 to 80% of its total energy remains in the steam as it leaves the engine. The Cochrane Multiport Valve and Steam-Stack Heater are essential to the proper handling of this steam.

Where exhaust steam is used for other purposes besides heating feed water there is just one heater, the Cochrane Steam-Stack, which saves from$50 to $500 in piping and extra fittings alone over any other arrangement.

The Cochrane Steam-Stack and Cut-out Valve Heater and Receiver has an extra large oil separator capable of purifying *all* of the exhaust steam from the engines. Even when the heater is cut out for cleaning, the separator and trap remain in operation and no by-pass is required.

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District Sales Offices : Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

DE LAVAL DIRECT-CURRENT TURBO GENERATORS

THE De Laval Multi-Stage Turbine, built in all capacities, is equipped with a speed-reducing gear which permits the turbine to be operated at the speed most advantageous from the point of view of economy, simplicity and satisfactory running, that is, with the fewest number of stages, shortest shaft, and proper bucket velocity, while at the same time permitting the generator to be of the ordinary standard-speed type.

Send For Our 100-Page Book "D61"

De Laval Steam Turbine Co.
TRENTON, N. J.

Turbine Equipment Co., Ltd., 204 Peterkin Bldg., Toronto, Canada; Messrs. Taylor & Young, 513 Pacific Bldg., Vancouver, B.C. 97

WHEELER
Condensers

Are celebrated throughout the world. The Wheeler Condenser & Engineering Co. was one of the first companies to concentrate its entire energy on the design of steam condensing machinery.

An office has recently been opened in

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Mr. Jos. MacKay, Jr., Manager.

Wheeler Condensers are built in Barometric, Jet and Surface Types for moderate vacuum and for the highest attainable vacuums for steam turbine work. Vacuums of 28, 29 inches and more are assured.

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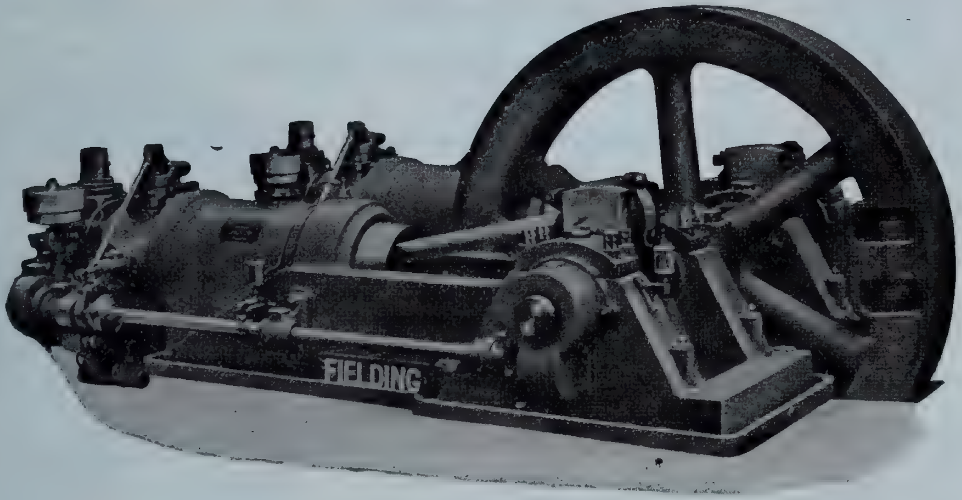
Montreal: 122 Board of Trade Building.

THE "FIELDING" GAS ENGINE
Suction Gas Cheapest Power Known

Strong **Steady**

Compact **Durable**

Simple **Safe**



Double Cylinder Type, 168 B.H.P.

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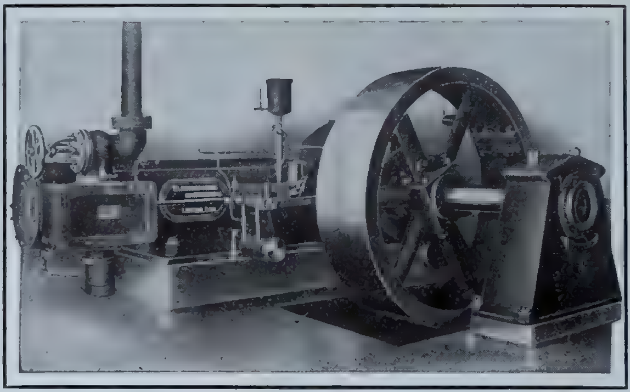
The CANADIAN BRITISH ENGINEERING CO., LIMITED

4 Queen Victoria St., London, E.C. **324 Smith St., Winnipeg**



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

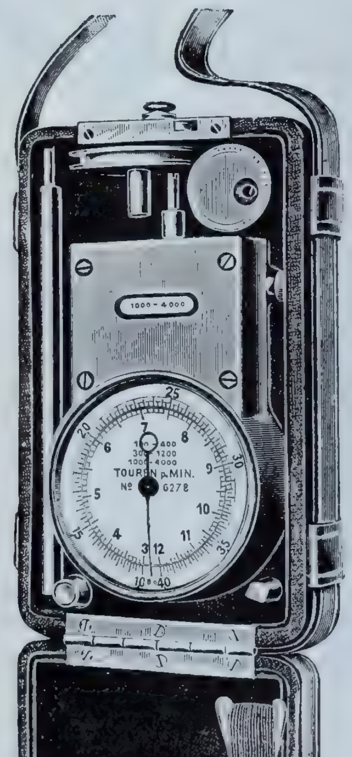
E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER



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(DR. HORN'S LATEST IMPROVED TYPE)

Excellent Quality —Moderate Prices

Hand and Stationary Instruments Suitable for all Purposes.

TESTING TACHOGRAPHS

Exceedingly Sensitive, Will Record the Slightest Change in Speed of Machine.

TACHOSCOPES

A Revolution Counter and Centre Second Stop Watch Combined to Operate Simultaneously.

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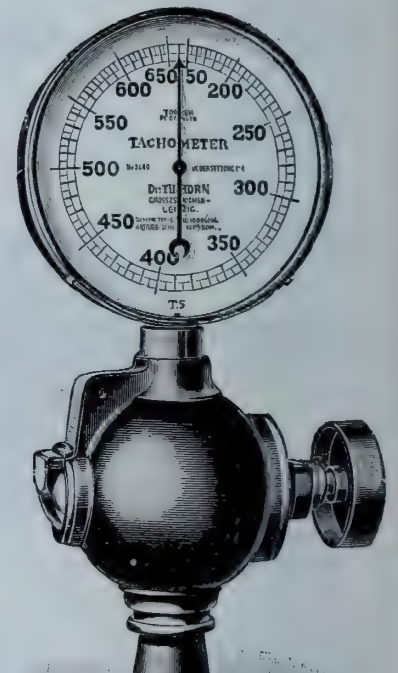
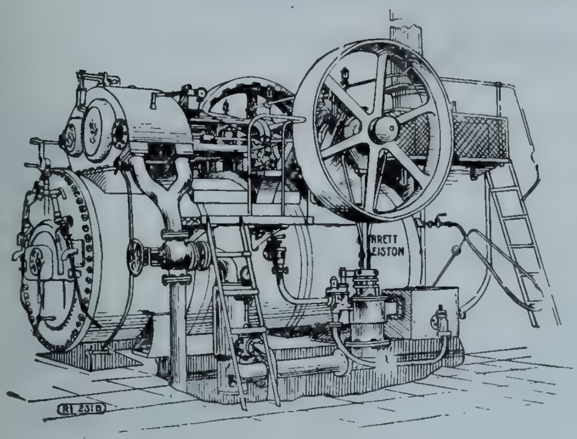


STEAM ENGINES

With Gas Producer Economy **Steam Engine Reliability**



THE GARRETT (SUPERHEATED STEAM SEMI-STATIONARY) ENGINE.

Require only 1¼ Lbs. OF COAL PER B. H. P. HOUR.

Sizes 40 H.P. to 250 H.P.

Can use any kind of fuel
Anthracite, Bituminous, Lignite, Wood, Shavings, Sawdust, Oil or Gas.

Just the Power for the Small Town.
Electric Light or Pumping Plants.
Mills or Factories.

Efficient, Reliable, Economical.

Correspondence Solicited.

Theodore Kipp Company

Union Trust Building **Winnipeg, Man.**

SUPPORT HOME INDUSTRIES

THE CANADA METAL CO., LIMITED, MANUFACTURE IN CANADA

Our **BABBITT** Sales for **1913** Have Beaten All Records

Year by year they increase by Leaps and Bounds.

The Reason:

What we make we guarantee.
Nothing is done by guesswork.

Mixtures and Physical Tests are controlled through our chemical and testing laboratories. All Babbitt Metals are tested with a friction testing machine.

This strict attention to details enables us to supply all requirements.

Ask for our booklet "Shakespeare and Babbitt Metals." Mailed free.

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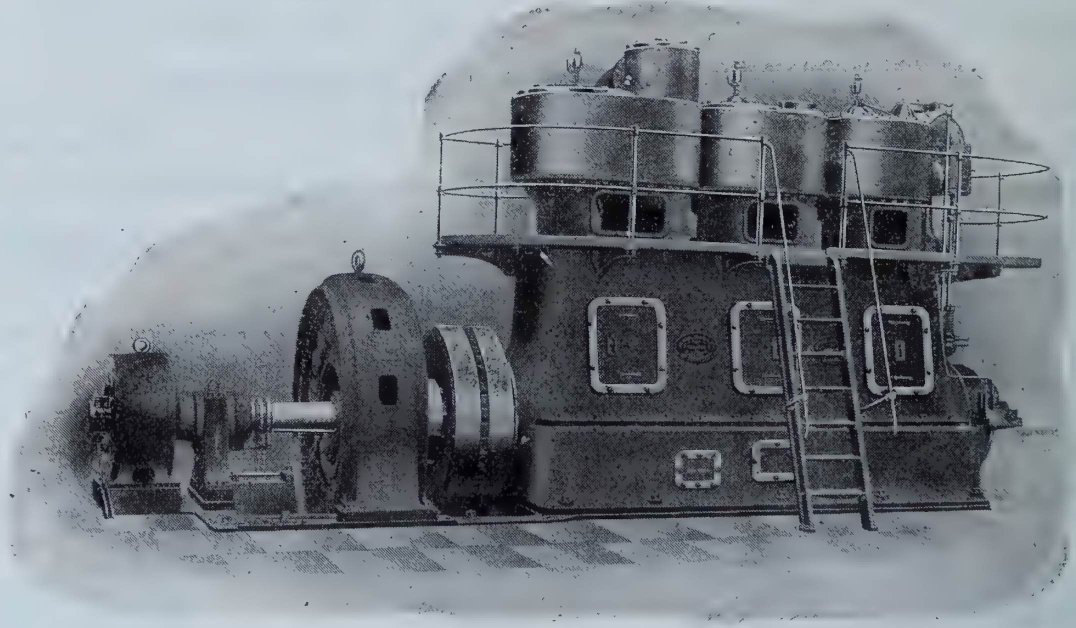
HEAD OFFICE AND FACTORY **TORONTO** BRANCH FACTORIES **Winnipeg, Montreal**

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.

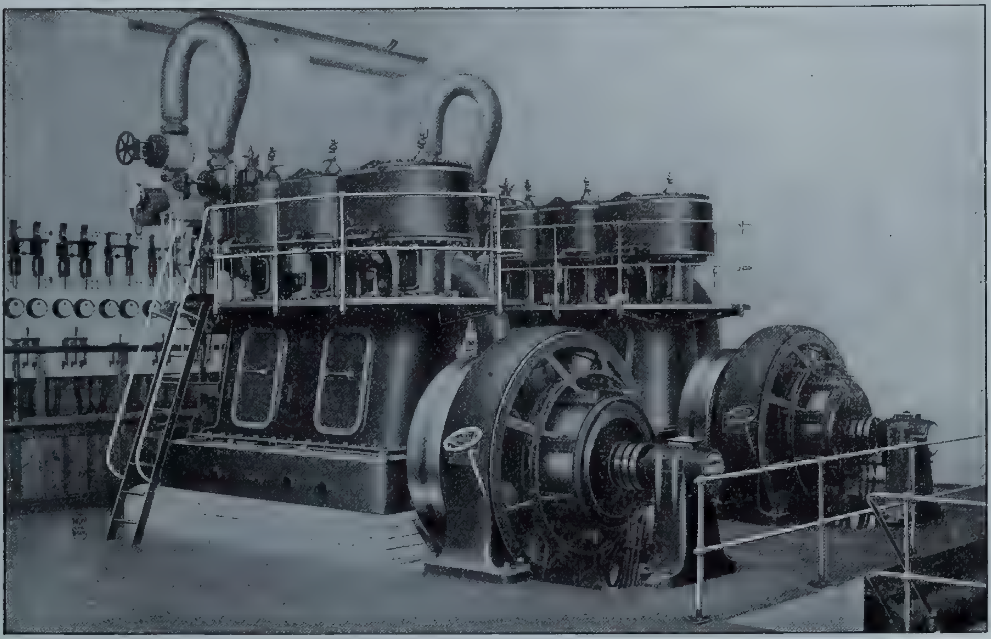
THE BELLISS ENGINE

THE HIGH-SPEED, DOUBLE-ACTING, FORCED-LUBRICATION ENGINE WAS ORIGINATED BY US IN 1890, AND SINCE THAT DATE WE HAVE ACTUALLY MANUFACTURED

5,000 ENGINES

REPRESENTING

1,000,000 HORSE POWER



600 H. P., 350 R. P. M., Belliss Triple Expansion Engine.

Two of the Above Type of Engines Recently Ordered for the Toronto Waterworks.

We have installed upwards of 150 Belliss Engines in Canada.

Manufacturers:

Belliss & Morcom, Limited

BIRMINGHAM **ENGLAND**

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211-212 Board of Trade Building **MONTREAL**

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Power House and Factory Design,
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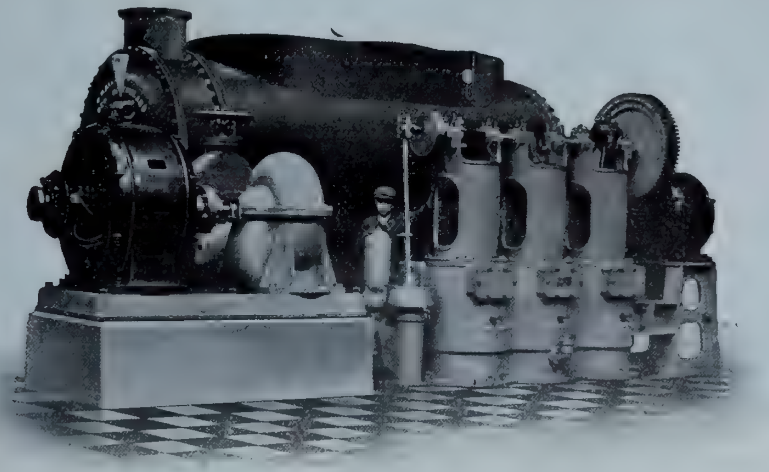

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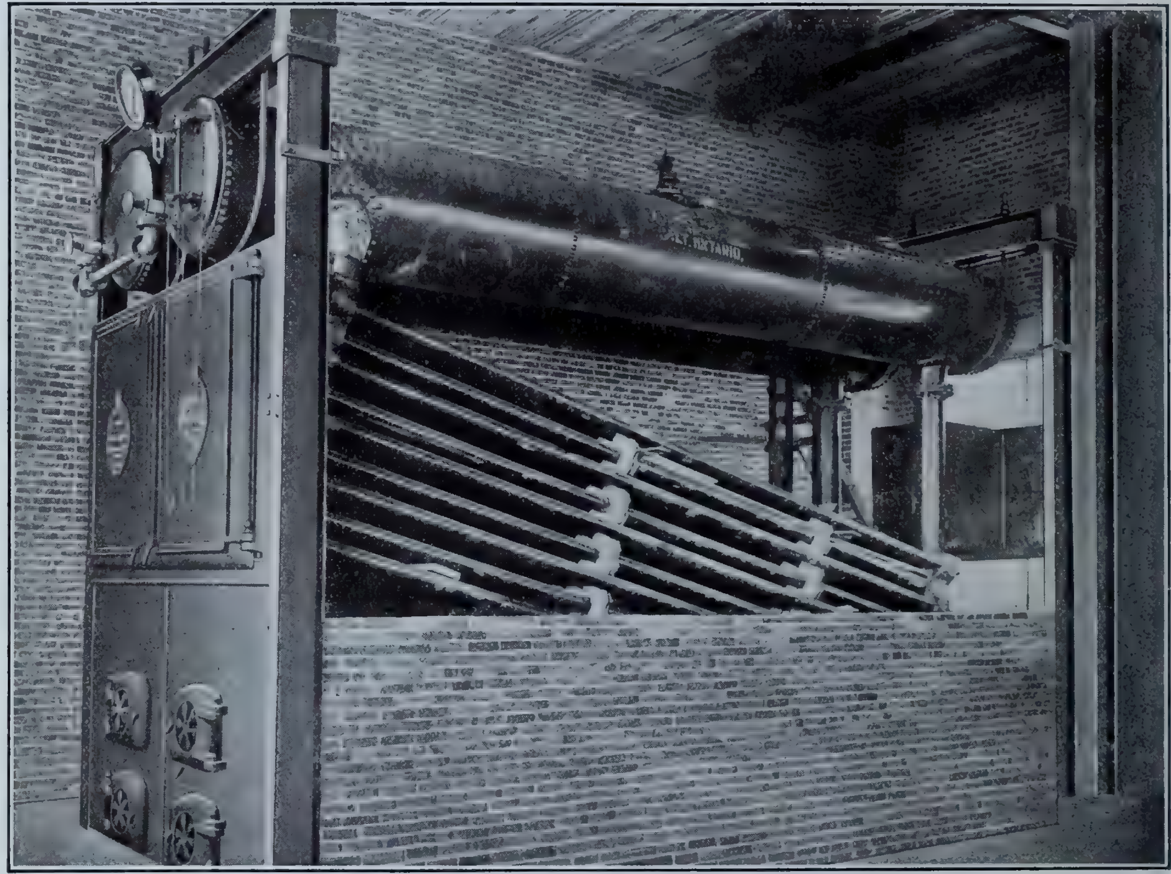

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Results of Neglected Leakage from Boiler Joints, Etc.--I.

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

ALTHOUGH generally well known and perhaps more or less appreciated, it does not appear that steam boiler owners and operators realize as they should the extent and rapidity of deterioration, not to speak of the insidious approach of the danger point, else more attention would be given to the immediate investigation and stoppage of leaks from joints and other parts of their steam generation units. It seems to us that too much indifference is shown because of the apparent paltriness of the leaks when they first develop, and that so long as there is little discomfort in evidence so far as the operative staff is concerned, and no interference with the output of the manufactured product is for the time being threatened, no action to have the trouble rectified is deemed necessary. We trust that a careful perusal of this series of articles will produce a change in the above adopted attitude to steam boiler leakages. The descriptive matter, along with the sketches, show the corrosive and erosive defects liable to develop as a result of neglected leakage from joints and parts not covered by brickwork. The thickness of the plates and depths of corrosion are given in millimetres, and it may help to a better conception of the dimensions if we add that one millimetre is approximately equal to 1/25th of an inch.

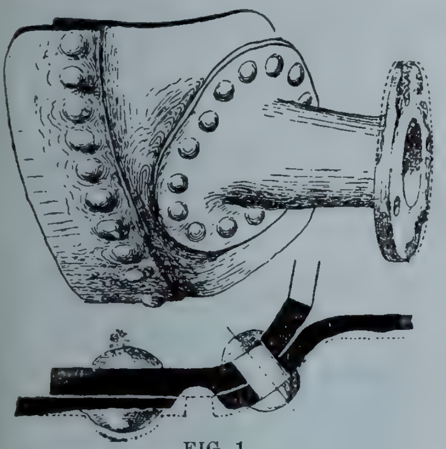


FIG. 1.

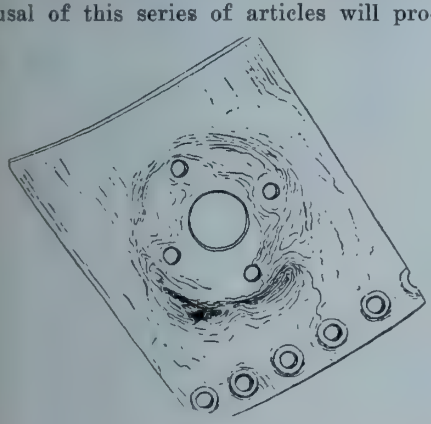


FIG. 2.

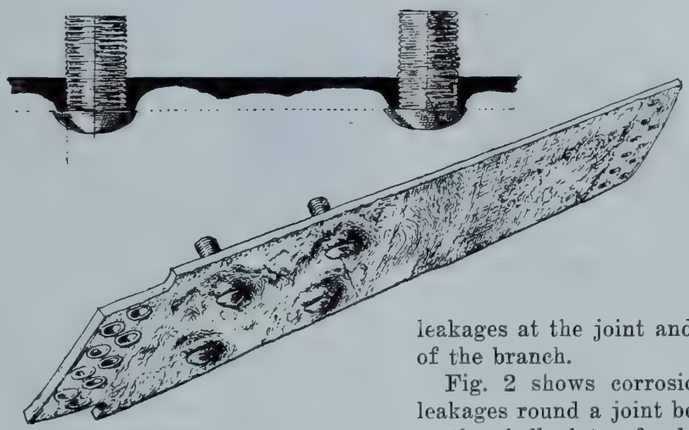


FIG. 3.

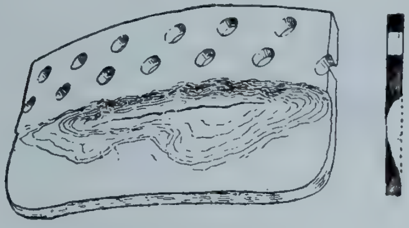


FIG. 4.

Fig. 1 shows part of the dished end of a superheater, and the report states:—

The edge of the shell ring (original thickness 9 m.m.) is corroded over a length of 490 m.m., a breadth of 60 to 100 m.m., and a depth of 2 to 5 m.m. The heads of the rivets are attacked, and the bottom of the dished end (original thickness 12 m.m.) is corroded from 2 to 5 m.m. The corrosion is most extensive near the beveled edges of the ring and of the branch, the latter being corroded generally from 2 to 4 m.m. The flange of an original thickness of 20 m.m. is also wasted, especially at the sides where the thickness is reduced to 6 m.m. The corrosion had its origin in leakages at the joint and at the riveting of the branch.

Fig. 2 shows corrosion produced by leakages round a joint bolted directly on to the shell plate of a boiler, the thickness of which was 9 m.m., and which was reduced to 2 m.m. at certain points. The corrosion in this case has only attacked one of the sides of the joints, but it extends over a breadth of 140 m.m. almost into the riveting.

Fig. 3 shows part of a marine boiler made in 1898. The original thickness of the plates was 17 m.m. Persistent leakages at the bottom of the middle circular seam have produced along the caulking and between the rivets corrosion to a depth of 7 to 8 m.m., and the whole of the part on which the water issuing from the leak has dropped is corroded. At the bottom of the front of the shell ring leakages occurred at four stays. Owing to the corrosion thus set up, a boss has been formed round each stay, and the corrosion has attained its maximum depth (9 to 10 m.m.) at some centimetres distance from the stay.

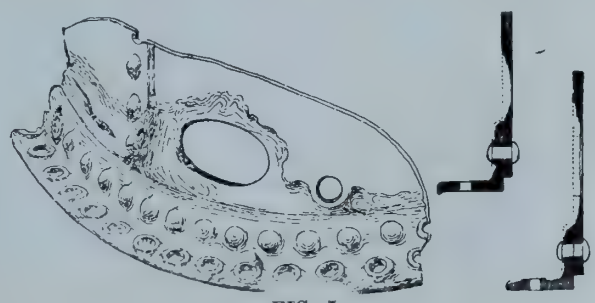


FIG. 5.

Fig. 4 also refers to a marine boiler. Corrosion at the bottom of the middle circular seam was caused by persistent leakages. The corrosion extends over a length of 400 m.m. and a breadth of 60 m.m. The thickness is reduced almost to nothing, and at the worst part the plate ultimately gave way. The original thickness was 15 m.m.

Fig. 5 shows the bottom of the shell of a small vertical boiler. Leakages at the riveting of the angle iron and at the joint of the wash-out opening have produced severe corrosion. The thickness of the horizontal plate of the angle iron is reduced in places at the edge to 5 or 6 m.m. The rivets in this part are now headless. The vertical plate is corroded from 3 to 4 m.m., and the rivets have scarcely any head left. Along the caulking of the angle iron at a height of 4 to 5 m.m. there exists a deep blotch of corrosion, and the thickness there is reduced in places to 2 or 3 m.m. (original thickness 13 m.m.). Around the door of the wash-out opening, particularly at the higher part, there is corrosion 20 to 30 m.m. in breadth. The remaining thickness of the plate is only 5 to 6 m.m.

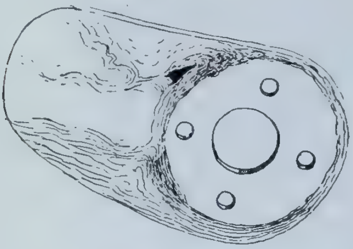


FIG. 6.

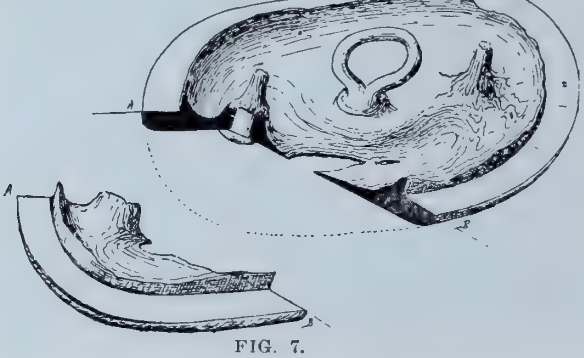


FIG. 7.

Fig. 6 indicates corrosion round a joint bolted on to a plate of 10 m.m. thickness. The grooving is 15 to 20 m.m. in breadth and 4 to 10 m.m. deep. At one point the plate has worn through into a hole, while, in addition, the leakage has caused two grooves 3 to 4 m.m. in depth to spread around the joint.

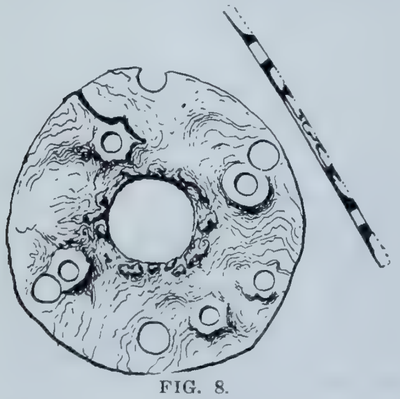


FIG. 8.

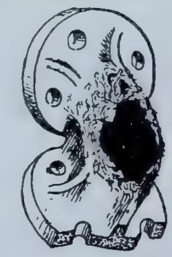


FIG. 9.

Fig. 7 is that of a cast iron manhole cover 25 m.m. thick. Leakage round the joint have almost eaten away the thickness of the projecting part intended to preserve the joint. The two attaching bolts of an original diameter of about 30 m.m. have been reduced to 12 m.m. In the middle there is severe corrosion, which at one point has eaten through the cover.

Fig. 8 shows the flange of a pipe corroded by leakage at the joint and round the bolts. The thickness of 11 m.m. is in places reduced to nothing, while at three of the bolt holes the portion of the plate which was covered by the nut is intact.

Fig. 9 refers to a cast iron blow-off elbow, of which the thickness is reduced to nothing by leakage at the joint. The pipe was found partly covered with dust and ash, which the leak kept in a damp condition.

Fig. 10 is that of a covering plate at the bottom of the front end plate of a boiler with internal furnaces. The bottom of the front end plate is very little above the level of the stokehole floor, and is frequently covered with ashes. Leakages from the manhole and ashes have caused very rapid corrosion of this plate, which was originally 20 m.m. thick. The corrosion commenced in the riveting of the stiffening ring of the hole, and in the bottom flange the thickness has been reduced to nothing over a space of about 500 m.m. On the same area, the rivets of the first circular shell seam are practically headless. Starting from this point, the corrosion gradually diminishes, and in the back part of the seam it is scarcely more than 2 to 3 m.m. in depth.

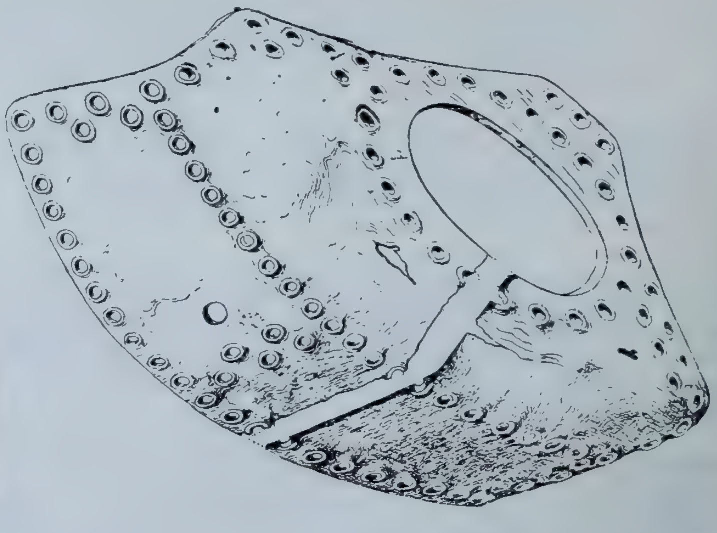


FIG. 10.

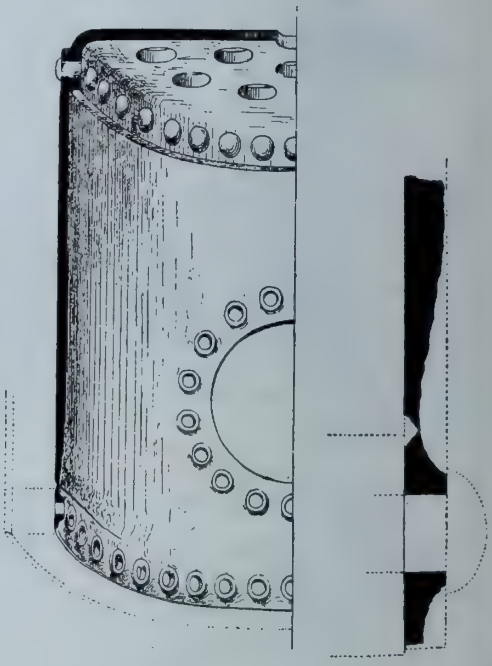


FIG. 11.

Fig. 11 refers to the bottom of the firebox of a small vertical boiler with smoke tubes. On the water side at the level of the foundation ring there are two grooves caused by corrosion, one covering a space of 400 and the other 300 m.m. These grooves are in parts 10 to

12 m.m. in breadth and 5 to 6 m.m. thick. On the fire side the bottom of the firebox is much corroded in and under the riveting, probably owing to the presence of ashes kept in a damp state by leakages at the riveting. In certain parts the edge of the plate has been reduced to between 5 and 6 m.m. in thickness. Many rivets are practically headless. Over a space of about 150 m.m. the plate is fractured at a place where the thickness has been reduced to nothing owing to the effects of internal and external corrosion at the same point.

* * *

DESIGN AND STRENGTH OF WORM GEARING.

By A. Best.

MUCH has been said at the meetings of our engineering societies, and much has been written in journals and text-books on the subject of gear strengths, but one may still look in vain for a simple solution to the problem of what power a given worm gear will safely transmit.

All gearing should be designed with a fair factor of safety, and in most cases now the size of the gear is more or less determined by the nature of the load: whether subject to shock or fairly steady. Another influential factor is the length of life expected from the gears. These conditions naturally cause the designer to get well beyond the point of destruction. It is found then that gears are really designed for wear, and it is, therefore, desirable to watch those points which, though they do not seriously increase the weight or cost of the gears, allow more accurate meshing. The consequences are—smoother running and longer life.

It may, perhaps, be imagined that by using a greater width of wheel face, an increased power can be taken through the gears. This is true only to a limited extent, because as the wheel gets wider, the diameter of the pitch surface at the sides of the teeth gets greater, and as a consequence the pitch is greater. When this increase is very great, the gears cannot mesh properly at those points, and inaccurate meshing, owing to the wheel teeth getting out of pitch, causes considerable friction and rapid wear. This fault often causes the excessive generation of heat. Gears overheated can frequently be remedied by reducing the angle of throat. When this throat angle is not allowed to exceed 70 degs., then the increase in pitch is not sufficient to seriously impair the working of the gears.

Another point to watch is the length of the worm, and if the latter be made of such a length that the ends are clear of the outside diameter of the wheel (at the bottom of the throat radius), there will be no fear of the rattle which is sometimes heard, when the ends of the worm threads strike suddenly into the wheel teeth instead of smoothly sliding into mesh. It has been said that this worm is too long—owing to the law that no tooth contacts can take place out of the line of action. This is all very well for a new pair of gears, but when wear has taken place, matters are slightly altered.

Chart Feature.

With regard to the strength of worm gears, the accompanying chart will serve to solve this problem for bronze worm wheels. Bronze wheels give the most satisfactory results—either solid bronze gears, or cut bronze rings shrunk on cast-iron centres.

To use the chart it is first necessary to assume any worm and wheel to give the reduction required, then proceed to find by the chart if the assumed gear is suitable for the power which it is intended to transmit. If not, the pitch or pitch-line diameter of the worm should be altered until the required power is obtained.

Next calculate the pitch-line velocity of the worm wheel as follows:—

$$\frac{\text{Pitch ins.} \times \text{No. teeth} \times \text{revs. per 10 in.}}{12}$$

=Pitch line velocity in feet per min.

Then find the position on the axis (L M) for the value obtained. Follow this horizontally to the curve in graph (A), down the corresponding ordinate and cross axis (L K) to the line in graph (B), marked with the linear pitch of the worm. Proceed horizontally across (K N) to the line in graph (C), representing the pitch-line diameter of the worm used. The point on the axis (N P) vertically under this will give the horse-power for which the gears are suitable. The method is based on the proposals put forward in this article, and will be found ready and reliable.—Page's Weekly.

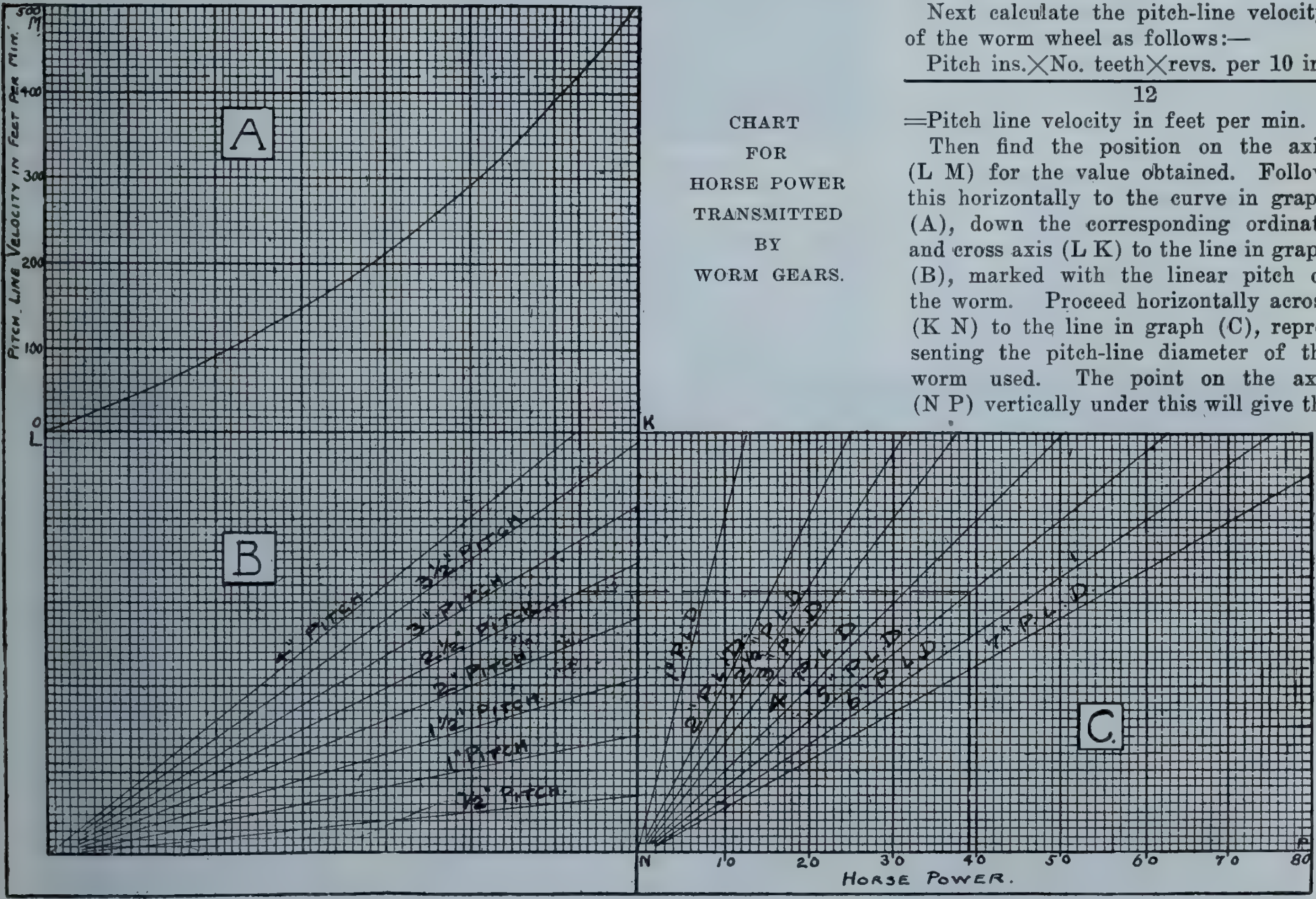


CHART FOR HORSE POWER TRANSMITTED BY WORM GEARS.

Description of a Testing Plant for Centrifugal Pumps

A testing plant for centrifugal pumps has been built at the works of Canadian Allis-Chalmers, Ltd., Rockfield, near Montreal, which can be reckoned, without fear of contradiction, we believe, as one of the best equipped and most up-to-date hydraulic laboratories on this continent.

A CENTRIFUGAL or turbine pump is not a positive displacement pump and there are no "rule of thumb" methods of arriving even approximately at its capacity. It may be accepted then that a well-equipped testing plant is one of the most important essentials for the successful manufacture of centrifugal pumps.

From the manufacturer's standpoint the records of tests carefully carried out are of the utmost value, as they constitute the foundation upon which future propositions can be based, designs developed, improved and modified to suit particular requirements. From the purchaser's standpoint, on the other hand, is the absolute assurance that the hydraulic and efficiency requirements have been fulfilled and, secondly, that a trial run of several hours' duration will insure continuous operation of the machine with no mechanical difficulties arising after leaving the works.

There are a number of testing methods in use with varying degrees of accuracy, and they may be classified as follows:

(a)—Weight or volume method.
(b)—Weir method.
(c)—Velocity meters.

The last group includes Venturi meters, nozzles and the Pitot tube.

The instruments required, pressure and vacuum gauges to determine the total head; watt meters to determine input to motor, or indicator to determine horse-power of steam engines, have long been standardized and are usually accepted without question by consulting engineers and representatives of purchasers on official tests; in any case their calibration is a simple matter and facilities are provided for this purpose at the Rockfield Works. The measurement of the quantity of water being handled, however, presents many difficulties, because the methods generally adopted, owing to their cheapness, such as weirs, nozzles, pitot tubes and, in fact, all velocity meters, are open to the very strong objection that their accuracy depends on constants determined by experiment which, as far as consulting engineer or official representative is concerned, may or may not be right. A means of direct measurement either by weight or volume is an absolute necessity.

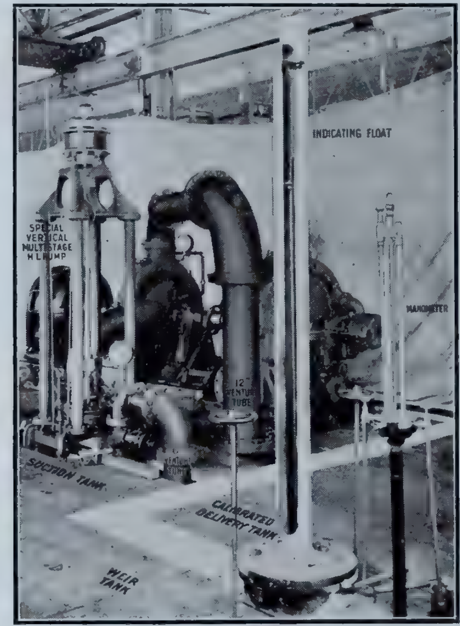


Fig. 2. CLOSE VIEW OF MANOMETER AND FLOAT.

Test Plant Details.

In the testing plant at the Rockfield Works, no one single testing method has been relied upon, but any one of the three above-mentioned testing methods can be used and the volume method can be used to check either the Venturi meters or the weir. It may be stated here that a testing plant established at the Mather & Platt Works, in Manchester, England, whose well-known centrifugal pumps, Canadian Allis-Chalmers, Ltd., have successfully manufactured for several years, served as a basis for the design of this unique equipment.

Figs. 1 and 2 represent general views of the testing plant and, referring to Fig. 3, the overall dimensions of the tanks alone, which are 34 ft. 6 inches long, 18 ft. 3 inches wide and 9 ft. 4

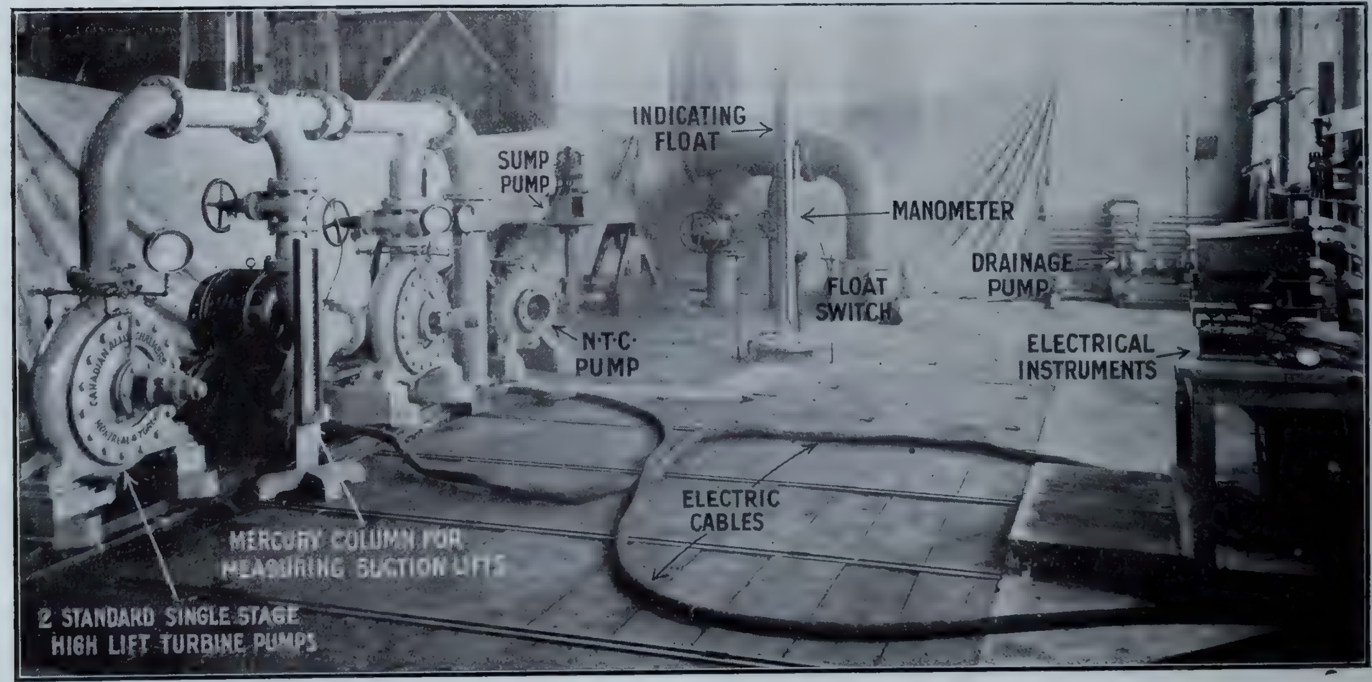


FIG. 1. GENERAL VIEW OF CENTRIFUGAL PUMP TESTING PLANT.

inches deep, will satisfy the reader that an equipment of such proportions is well able to cope with the largest pumping units. It can be seen that all tanks have been placed underground so that factory space is not wasted and the flooring made in such a way that the tanks can be easily uncovered. The total area has been divided into three tanks. The suction tank is 18 ft. 3 inches long, 15 ft. wide, 9 ft. 4 inches deep. The calibrated delivery tank is 18 ft. long, 11 ft. wide, 7 ft. 4 inches deep, and the weir tank is 18 ft. long, 5 ft. 9 inches wide by 7 ft. 4 inches deep.

All tank walls are made of waterproofed concrete and the bottoms carefully leveled. By raising the bottom levels of delivery and weir tanks above the suction tank, they drain by gravity through connecting valves into the suction tank. A small motor-driven centrifugal pump, which can be seen in the right-hand corner of Fig. 1, serves as drainage pump for all tanks. Suction pipes with foot valves and strainers of various sizes may be noted in the suction tank, and little time is lost in making the suction pipe connections when pumps about to be tested are bolted to the cross rails, thus providing a firm setting-up.

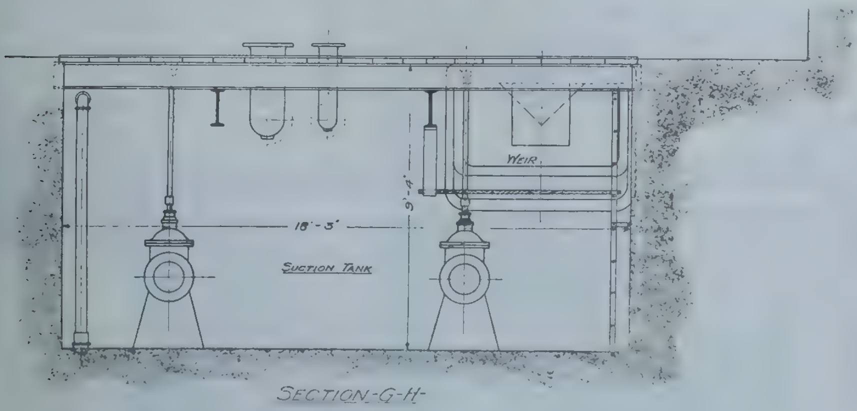


FIG. 4. CROSS SECTION OF SUCTION TANK.

The discharge connections are formed by two elbows, a 6-inch and 12-inch which connect to a 6-inch and a 12-inch Venturi meter respectively. Following the discharge pipes, they are carried to a common large pipe, which finally connects with a water switch, the function of which will be described later. By removing a blank flange, a passage can be made from the delivery tank to the weir tank. On the wall dividing the delivery tank from the weir tank can be seen a Manometer which, by means of pipe connections to the Venturi meter tubes, registers the amount of water flowing through the tubes. Next to this instrument is mounted a float with indicator which shows the height of water in either delivery or weir tanks by opening and closing valves.

Referring to the weir tank, the cast iron weir frame may be noted which is set in the wall dividing the weir tank from the suction tank. Weirs of the V-notch shape, and rectangular weirs of 18, 22, 24, 35 and 48-inch widths can be inserted in this frame. A ladder with a platform has been provided to allow the test operator to descend and observe the leveling and careful setting of the weir crest to the zero mark of the float scale. Baffle plates in the weir tanks can be raised or lowered in wall frames to best advantage to check any disturbances of the water and to insure a quiet flow near the weir. A table with the necessary electrical instruments to measure the

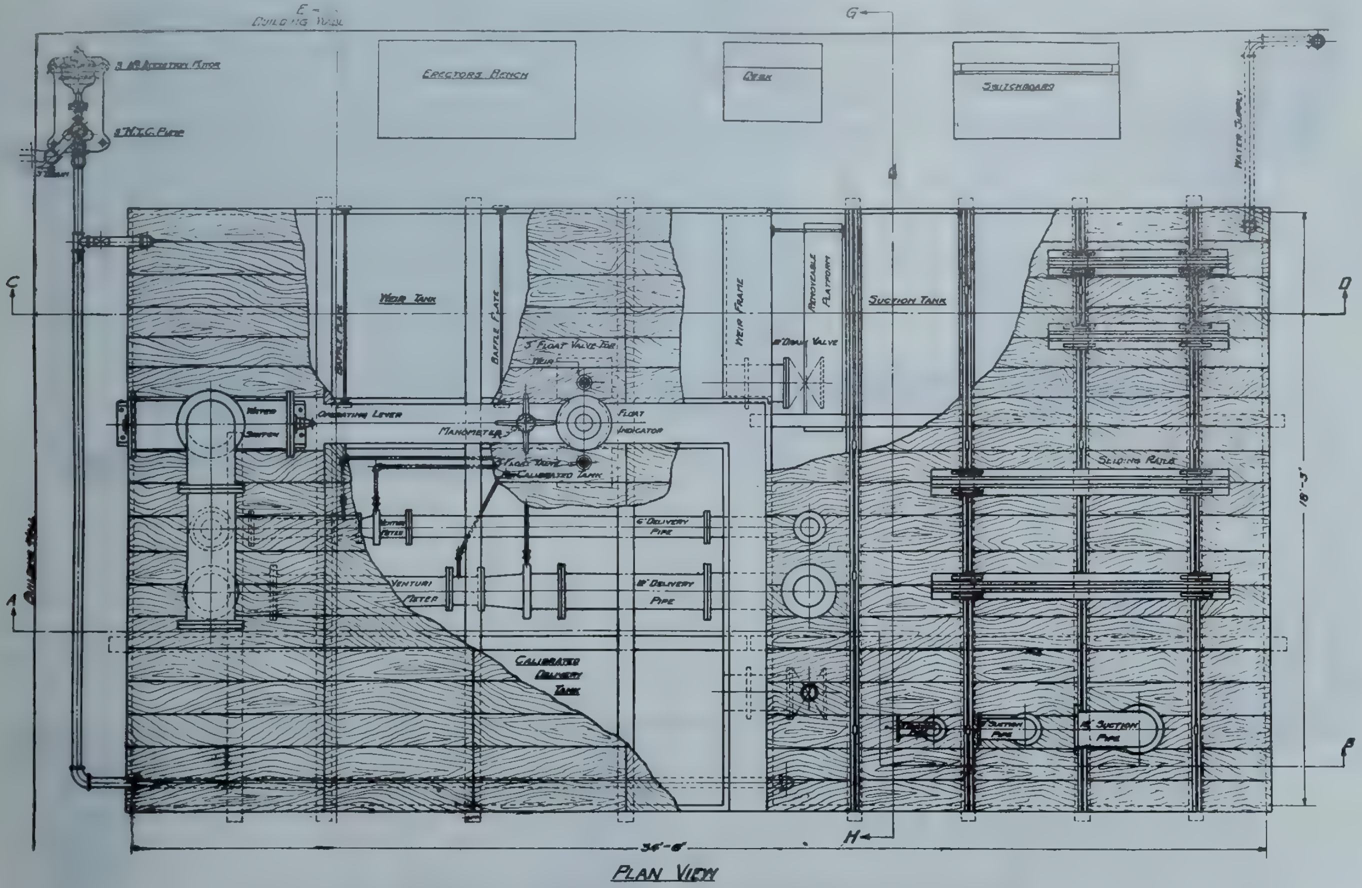


FIG. 3. PLAN OF TANKS SHOWING LAYOUT OF METERS AND PIPING.

electrical input, and engineer's desk and a fitter's bench complete the equipment.

Method of Test.

The method of test is as follows: All suction pipe connections are made with the above-mentioned pipes in the suction tank. The discharge connection is made with one of the two elbows, according to the size of pumps to be tested, and the water is discharged direct into the water switch. By operating the hand lever, the water can be instantaneously switched either into the calibrated delivery tank, or into the weir flume. As the name indicates, the delivery tank, although of uniform section, has been carefully calibrated by weighing the water and noting the rise of level on the float scale. Assuming that the operator by means of the water switch has directed the flow into the weir flume, he next observes the weir flume scale on the float and the manometer reading at the same time, thus checking the weir against the Venturi meter. The float is now closed to the weir tank and opened to the delivery tank. The level of the water in the delivery tank having been observed and, with stop-watch in hand, he throws over the water switch lever, allowing the water to fill up the delivery tank.

The operator allows the pump to discharge into the delivery tank for from say one minute in the case of ten thousand gallons per minute pumps to even half an hour if required for five hundred gallons per minute pumps, and noting the time, switches the discharge from the pump back into the weir flume whence it continues to circulate round. At his leisure, and when the water in the delivery tank is quite still, the operator observes the new level and, subtracting

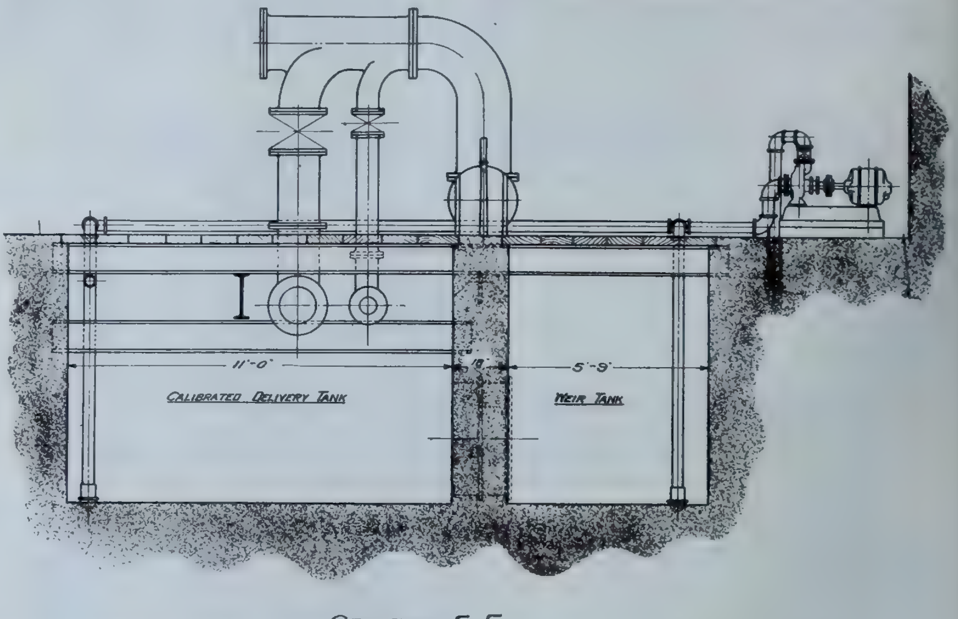


FIG. 6. CROSS SECTION OF DELIVERY AND WEIR TANKS.

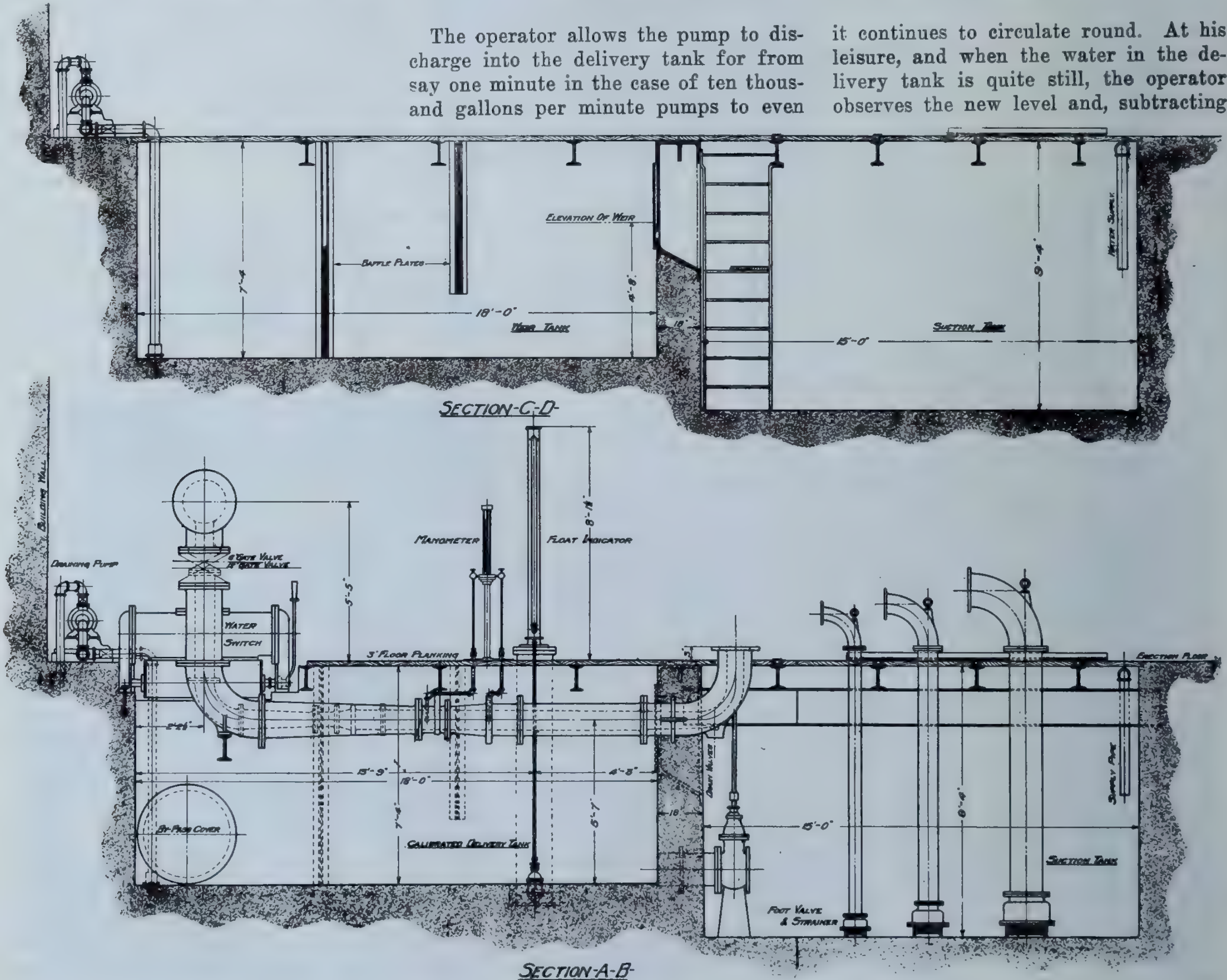


FIG. 5. SECTIONS OF WEIR, SUCTION AND DELIVERY TANK, SHOWING SUCTION PIPES AND METERS.

it from the original level, arrives at an exact volumetric measurement of the water passing through the pump. Note here also that the water is still passing through the Venturi meters, thus checking them against the delivery tank. Thus, the Venturi meter checks the weirs, and the volumetric measurement checks the Venturi meter.

For quantities over 10,000 g.p.m. the discharge is delivered direct into the delivery tank through by-pass into the weir flume and over the largest weir which, having been checked up to 10,000 g.p.m. may reasonably be assumed to be exact for larger quantities.

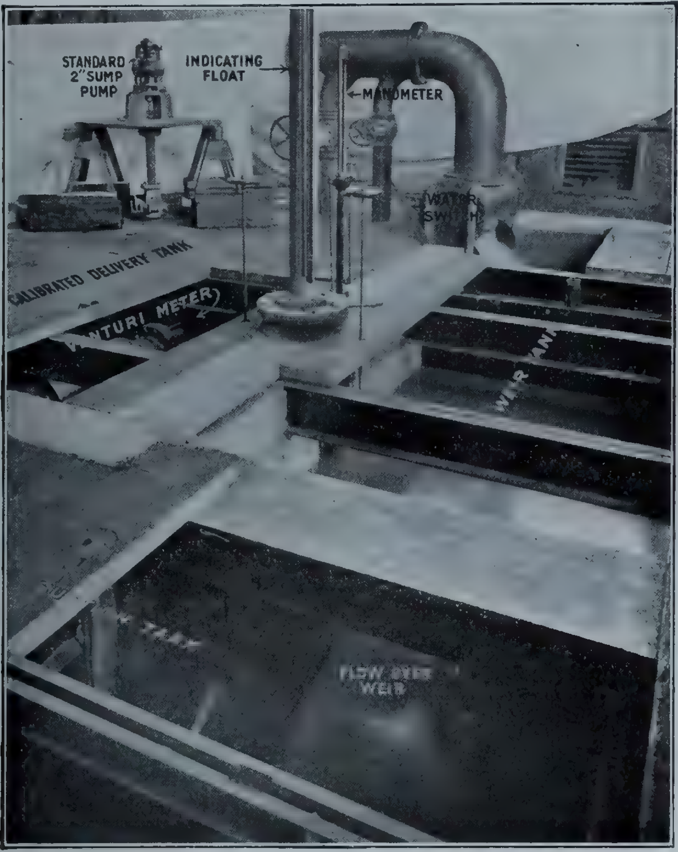


FIG. 7. FLOOR REMOVED, SHOWING WATER TANKS AND WEIR.

Fig. 7 shows part of the flooring removed with water flowing through the water switch into the weir flume and over the weir.

Fig. 2 shows a closer view of manometer and float, also illustrates the possibility of preparing and setting-up, for test, two pumps at the same time.

There is also a complete electrical testing department, fully equipped for making all tests necessary to determine the performance curves of motors, up to the largest sizes. A Prony brake equipment is also available for testing the smaller sizes. Power is received in the electrical testing department from 3-wire d.c. factory circuit at 220 volts; is then transformed by means of suitable motor generator sets and transformers, and then relayed to the testing table in the pump testing department shown in Fig. 1, where the readings of power input to the machine under test are made. Direct current at 110-220 and 550 volts, and alternating current at all standard voltages and frequencies are available. The power available is 400 h.p. for d.c., and 60-cycle a.c. motors, and 200 h.p. for 25-cycle a.c. motors.

It may also be mentioned that steam inlet and exhaust pipe connections are available at the test plant and small or large steam turbine-driven pumps can be as easily tested as motor or belt-driven units.

* * *

PREVENTING STEAM BOILER ACCIDENTS.

THE following instructions for boiler operation and repair, taken from the book of rules issued by the Inland Steel Company, should prove of interest to all boiler owners and operators.

1—Two men should always work together when cleaning out boilers, it being the duty of one man to remain on the outside all the time and in a position to see the man working inside so as to give assistance in case it is needed.

2—Never go into a boiler until you have locked the steam valve and closed all other valves.

3—Before entering a boiler, put a torch or candle inside to determine the presence of gas or bad air.

4—In cutting a boiler in and out, use the non-return valves exclusively, in order to insure their proper working. Should the non-return valve fail to work in any instance, notify the foreman immediately.

5—The automatic valves should be examined sufficiently often to insure their prompt action in emergencies, such as the bursting of tubes.

6—When boilers are taken off for cleaning, the main stop valve in the steam connections should be shut off and dependence not put on the automatic quick-closing valves alone.

7—A sign, "Danger, do not move," should be hung on the steam valve of any boiler when the latter is shut down.

8—Never open a slide or valve when a danger sign is attached and until you have seen that no one is in the boiler.

9—Safety valves should be tested every shift.

10—When opening up any steam line take the following precautions:—(a) Open all available drips; (b) warm the line by opening the by-pass when possible, or by opening the stop valve sufficiently to warm it slowly; (c) never allow an inexperienced man to turn steam into a cold line, unless accompanied by the foreman; (d) never open the main valve until certain that the line is thoroughly heated.

11—When starting up a boiler that has been dead, raise steam slowly, drop the pressure a few pounds on remaining boilers in the battery, and do not open the stop valve until the gauge on the dead boiler shows the same pressure as the other boilers; then open the stop valve slowly.

12—All steam trape taking care of large lines should be kept clean and in working order, as this is the only safe way to remove water from the line. Should a trap get out of order and it is impossible to repair it at once, the bypass should be opened sufficiently to eliminate all water that might collect. Blow off boilers every shift.

13—Leaks in pipes. flanges and gaskets should be repaired at the earliest possible moment, as they may be caused by defective material.

14—Keep the water glasses clean and the tops and bottoms open by frequent blowing out every shift.

15—In determining water level, try cocks should be frequently used, and dependence not wholly placed on gauge-glasses.

16—Never tighten any bolts or nipples or do any caulking while steam pressure is on the boiler.

17—Take great care in cooling and handling flue dust, as it is liable to fly, slide and explode, causing bad burns. Never step on it.

Breakdowns of Stationary Engines, Their Cause and Cure-III.

By Michael Longridge

The accompanying article, which formed the subject of a recent lecture before the Graduates' Association of the Institution of Mechanical Engineers, is one of special interest to power plant operatives. While this is so, the fact that faulty design and careless installation have played a large part in many "smash-ups," makes the advice relative thereto of considerable value to those also whose work lies in these particular spheres. The author of the paper is the well-known Chief Engineer of a large and leading English power plant equipment insurance company.

IN our March issue the contributory part that flywheels, valves, and valve gears, pumps, bed-plates and cylinders, played in the matter of stationary engine breakdowns was discussed. In the present article the relative place which pistons and piston rods, connecting rods and crank pins occupy is dealt with.

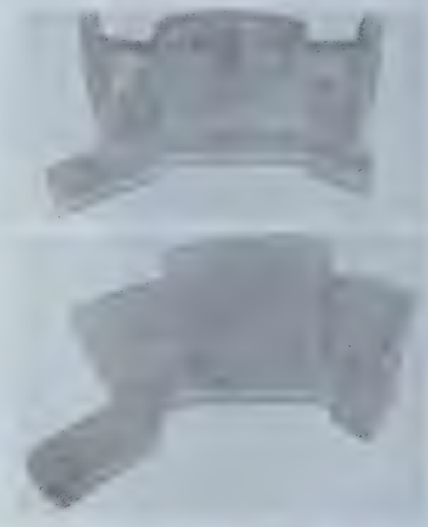
Pistons and Piston Rods.

Previous to 1899, breakdowns originating in pistons averaged 2.5 per cent. of the total breakdowns. Since then the average has been 4.8. The rise came suddenly soon after the rise of steam pressure to 160 lb., but I do not know that there is any connection between the two. During the last three years, 47 per cent. of these breakages have been caused by stray screws, or bolts, or broken rings; 17 per cent. by water, and the rest in various ways. When the substitution of plain pistons, with cast iron rings sprung into grooves, for pistons with junk-rings and fancy packings is complete, breakdowns from piston breakages will be halved.

Breakages of piston rods occur nearly always at the cotter-holes at the crosshead end, and are due to concentration of stress at the edges of the cotter-holes, as explained by Dr. Unwin on page 223 of the Part II. of his "Machine Design" 1912 edition. I indorse his explanation, and Figs. 17 and 18 afford convincing proof that cotters do bend in the way indicated by the drawing in his book. These figures are from photographs of two pairs of folding-wedges from the piston-rods of two old beam-engines after exhibitions of water in the cylinder. I would have shown single cotters, such as are generally used, but I, unfortunately, have none by me at the moment; moreover, I am not sure that folding-wedges are not preferable to single cotters, because a piece with parallel sides is easier to fit accurately than a tapering wedge; but if they be used, it is clear that the position of the pieces shown on the cut should be reversed, the broad piece should bear on the rod, and the narrow on the crosshead.

Connecting Rods.

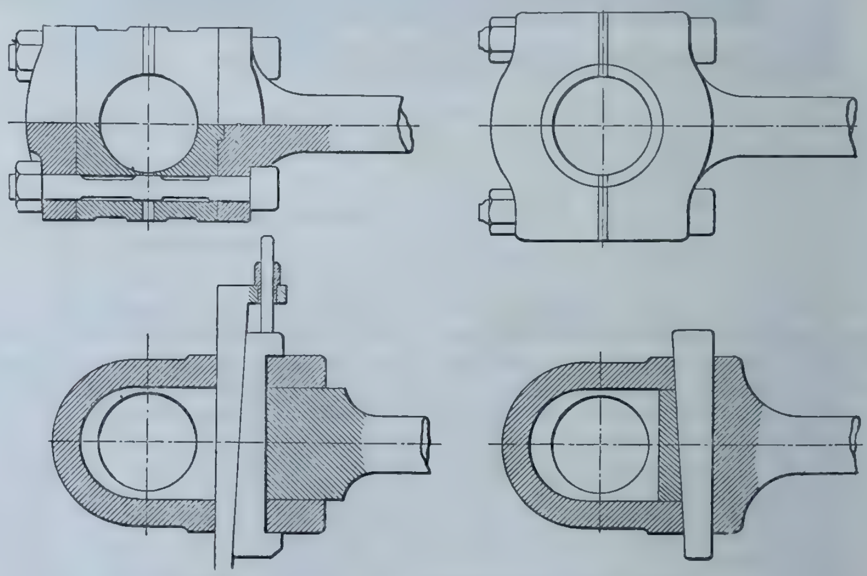
Fractures in connecting-rods occur generally at the ends which couple the rods to the crank-pins or crosshead centres; sometimes in the forks, when the crosshead ends are forked; and rarely in the body of the rods.



FIGS. 17 AND 18. PHOTOGRAPHS OF TWO PAIRS OF FOLDING WEDGES FROM PISTON RODS OF TWO OLD BEAM ENGINES, AFTER EXHIBITION OF WATER IN CYLINDERS.

The commonest types of end fractures are:—The box end or closed eye, Fig. 22; the open strap secured by gib and cotter, Fig. 21; and the marine end with cap and bolts, Figs. 19 and 20. Of the three, the marine end, Figs. 19 and 20, is, in my experience, the least safe, because of the frequent breakages of the cap-bolts, usually at the junction of the head and shank, or at the screw thread. The principal causes of these breakages are repetitions of stress or blows, abrupt changes of form, cross-bending stresses produced by the inertia of the rods.

The antidotes for the first are probably spare bolts, to give alternate periods of rest and service. Annealing is risky in unskilled hands. For the second, large fillets at junctions of heads and shanks, gradual reductions of diameters in shanks, and threads with rounder roots than the British standards. Fillets, cones, etc., at changes of section must be very neatly finished where they merge into the cylindrical parts, and threads very carefully chased, especially in steel, to leave nothing in the nature of cuts or scratches to initiate cracks. Stiffer palms and caps, also are often needed to prevent deformations, which would be apparent on reference to an india-rubber model; with consequent concentration of stress on one side of the bolt.



FIGS. 19, 20, 21, 22. CONNECTING ROD ENDS.

For the third, bolts with areas instead of diameters, approximating to half those of the rods, and the substitution of jaws, Fig. 20, long enough to hold at least one of the brasses, for palms, Fig. 19, are suggested. Rods like Fig. 19 should be tabooed, for it is easy to imagine the effect of a cross-bending stress if there be any wear or slackness. Bolts of small engines are more heavily strained by this stress than large, because the ratio of their length to their diameter cubed is greater. For connecting-rod bolts, wrought iron is a safer material than steel.

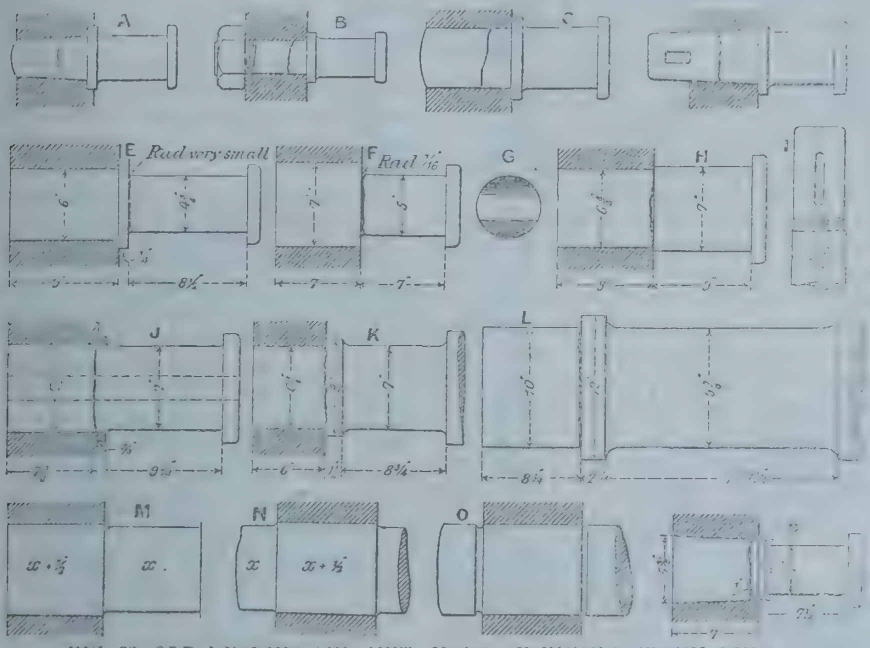


FIG. 23. OLD DESIGNS AND METHODS OF FIXING CRANK PINS.

Open straps, Fig. 21, secured by gibs and cotters are but little safer than marine ends. The jaws of the cotters wear, the straps open under the cross-bending stress produced by the inertia of the rod, and break, generally through the oil-hole. Fracture almost invariably begins on the inside surface, and when it has extended a certain distance, often not far enough to be visible above the flange of the brass, the strap breaks and opens out. Never trust a strap till you have seen the inside surface. Open straps should be kept closed on the butts of the rods by bolts in place of, or in addition to, the gibs.

Of the three forms, the box end, Fig. 22, is undoubtedly the most reliable. Fractures, when they occur, usually commence, as in the straps, on the inside surface at the hole for the lubricator, but extend slowly enough to be discovered before the rod gets free. Among more than 6,000 breakdowns of engines of various kinds I can only find one where fracture of a wrought-iron or steel box-end caused damage to an engine, and this was the fault of the engineer-operator, for the fracture had been visible on the outside surface of the end as far as the lubricator-hole some time before the rod gave way.

Crank-Pins.

The history of crank-pins has been very like that of cylinders, showing a rising percentage of breakages, culminating in the five years 1894-1898, and then falling. The rise was due to bad designing, improper methods of fixing, and over-loading; the fall to the more general adoption of the right method of fixing, combined with reduction of stress. In my early days, stresses of 12,000 to 14,000 lbs., per sq. inch were common, and stresses of 50 per cent. higher were frequently met with. Samples of the old designs and methods of fixing are shown in Fig. 23. In Fig. 23, (A), (B), (C), (D), are examples of pins with conical or cylindrical shanks fitted into the cranks and secured by riveting, screws and nuts, or cotters. They usually broke inside the crank-eyes, because the fit was not accurate enough to prevent slight movements which wore and enlarged the ends of the crank-eyes next the journals, thus throwing back the point of support and increasing the bending moments.

It will be noticed that the pins were put usually in from the faces of the cranks, so that they could come out and wreck the engine when they broke. Typical examples are indicated at (E) and (F). They have not sharp corners at the junctions of the journals with the collar, though such were not unusual; but the fillets provided, 1-16 in. to ⅛ in. radius, are too small to be effective. Both pins were of steel. The fractures were due to bending stresses. They commenced at the parts of the circumference nearest to, and furthest from the crank-shaft, and extended inwards as shown on the shaded part of (G), Fig. 23. The lives of these pins were 14½ and 104 million revolutions, and the bending stresses 17,500 and 11,500 lbs. per sq. in. respectively.

The breakage of (H) may have been entirely due to the abrupt change of diameter from 6¾ in. to 7 in. for piston-rods in direct tensile stress will break with a smaller change than is shown at (I), Fig. 23; but probably it was started by the shearing action of the edges of the crank-eye, when cooling and contracting upon the pin.

The failure of the pin (J) can be attributed to nothing else but shear. It was made of steel, of 60,000 lbs. tensile strength, 29½ per cent. extension in 6 inches, 60 per cent. contraction of area, and a strip cut out of it after the breakdown, was bent cold nearly double without cracking. It broke under a stress of 9,400 lbs. per sq. in., after 5¾ million revolutions. I think the crank-shafts (K) and (L), Fig. 23, are similar cases. The stresses and lives were: For (K), 8,200 lbs. per sq. in., and 17 million revolutions; and for (L), 5,000 lbs. per sq. in., and 218 million revolutions; the longer life of (L) being due to the lower stress, and probably to a lower pressure exerted by the crank in cooling.

I do not think the effect of the pressure of sharp edges or even of scratches in starting skin-cracks in steel, or the almost inevitable extension of such cracks under recurrent stresses, is sufficiently appreciated. About scratches I shall say a few words presently. Of shrinkage, I say without hesitation that the portion of the internal piece upon which an external piece is to contract should be of larger diameter than the adjacent portions, and that the external piece should entirely cover the enlarged portion of the internal.

At (M), Fig. 23 is shown how a crank-pin should be put in, while (N) and (O) show the proper method of shrinking a piece upon a shaft. It is to the adoption of this principle by many engine-makers, combined with reduction of working stress to 8,000 lbs., or 9,000 lbs. per square in., that the reduction in the number of crank-pin breakages must be attributed. The failure depicted in (P) is one of those things "no feller can understand."

* * *

Engineers' District Council.—A district council of engineers and firemen was formed on April 25, and will be known as "the District Council of Steam and Operative Engineers of Montreal and the Vicinity." The trades represented in the organization will be the portable engineers, Local 550; Court Partier, of the stationary engineers, and the International Brotherhood of Firemen, Local 233 Officers were elected as follows: President, H. Girardot; vice-president, A. Archambault.

The Design and Construction of Hydraulic Turbines*

By H. B. Taylor, M. Am. Soc. M,.E.**

The development of the water powers of the world has turned the inventive genius of men in the direction of machine design distinct from that akin to steam operation, and the achievement realized in the latter sphere is being to a large extent duplicated in the production of engines whose motive power is derived from the harnessing of waterfalls in this and many other countries where the particular natural resources are available.

METAL FEATURE OF CORROSION.

While corrosion is primarily caused by faulty design, some metals are more prone to its action than others. For example, bronze resists corrosion better than does either cast steel or cast iron; but if the runner is so designed as to permit corrosion to take place, it matters little what metal is used. Runners regulated by means of cylinder gates are particularly subject to corrosion, owing to the eddies produced behind the cylinder gates at fractional gate openings. Corrosion will often develop in a runner if the turbine be operated continuously at low gate openings. The falling-off of the efficiency of a turbine at low gates is an indication that the hydraulic conditions within the runner are greatly disturbed, and this disturbance tends to promote corrosion. High specific speed runners, if applied to high heads, are also subject to corrosion, owing to the high velocities to be dealt with and the difficulty in making the water follow the radical curves characteristic of the vanes of these runners.

Cast iron to-day is used as a material for runners to a much greater extent than heretofore, and, as a result of careful designing, it has been successfully employed under conditions which, until recently, were thought to be impossible. As an example, in the case of the four 18,000 horse-power turbines operating under a head of 420 feet in the plant of the Great Western Power Company, it might be mentioned that two of the units were equipped with runners of special bronze, the third with a runner of cast steel, and the fourth with a runner of cast iron. These turbines have been in operation since 1908 and a recent inspection has shown all of the runners to be in equally good condition, there being no evidence of serious corrosion.

Cast steel is thought to be the most undesirable metal from considerations of corrosion, on account of the unavoidable roughness of the surface. In the casting of steel runners it is very difficult to make the metal flow into the thin vane sections without chilling, unless extremely high temperatures are employed. These temperatures often result in the production of uneven surfaces, on account of the difficulty of obtaining sufficiently refractory material for the surfaces of the mold.

Draft Tube Relation to Corrosion.

Corrosion has often been greatly accelerated because of poor draft tube conditions. It has been only recently appreciated that the total draft head acting on the turbine, or the negative pressure on the discharge side of the runner in feet of water, is equivalent to the vertical distance from the tailwater elevation to the runner, plus the head corresponding to the velocity of the water as it passes through the discharge section of the runner, minus the losses in the draft tube, minus the head corresponding to the velocity at the discharge section of the draft tube. In modern plants, the last two factors entering into the total draft head have been kept within negligible values.

It is evident that should the total draft head, or the sum of the static draft head and the velocity head at the runner discharge, exceed the height of the water barometer, the continuity of flow of the water on leaving the runner is destroyed. When the absolute static pressure in the draft tube falls to a value equal to the vapor tension corresponding to the temperature of the water the water will vaporize and the draft tube will not be filled with a solid column of water from the tailrace to the runner. Therefore, the placing of a turbine simply within 34 feet from the elevation of tail-water is no indication that the elevation has been properly chosen; for aside from the limitations outlined above, it is also necessary to allow at least three or four feet margin between the total draft head and a perfect vacuum to prevent the breaking of the column of water in the draft tube due to inertia effects resulting from sudden changes of load on the turbine.

It must also be borne in mind, and this is a point which has been frequently overlooked, that in figuring the margin between the maximum vacuum and the total draft head, the maximum vacuum should be considered for the particular elevation above sea level at which the turbine is to be installed. The fact that the question of draft head has not been clearly understood has resulted in the location of a great number of turbines at such heights above tailwater that the benefit which would otherwise be secured by means of the draft tube has been largely sacrificed. In a number of cases where the draft head has been excessive corrosion of the runner vanes has developed at a rapid rate, and this corrosion has also attacked the runner band and draft tube in the neighborhood of the runner.

If, therefore, the runner vanes be so designed as to give sufficient contraction to the stream to prevent the water leaving the vane surfaces, if the speed selected be consistent with good hydraulic conditions, and if the elevation of the turbine above tailwater level be properly selected, there is no reason for anxiety over the possibility of corrosion developing to any appreciable extent. In respect to erosion, however, although the best means are used in resisting its action and high factors of safety are adopted in all parts of the machinery which may be subjected to it, erosion must necessarily be expected wherever the quality of the water is such as to produce it.

High Capacity Runner, and Vertical, Single Runner Turbine.

Until two years ago, a very large majority of turbines applied to low heads were either of the vertical shaft, multi-runner type, or of the horizontal shaft, multi-runner type. The reason for using more than one runner on the shaft which, from a mechanical standpoint, is not desirable, was that this arrangement permitted high rotational speeds, and, therefore, economic sizes of generators. During the past two years, however, the general adoption of the single runner, vertical shaft turbine for low and medium heads, has been witnessed. This change in the type of unit has been made possible by recent progress in the design and development of high capacity runners. Thus, for a given head and speed it is now possible to secure from a runner a greater output than was possible two or three years ago; or, conversely, for a given head and capacity it is possible to operate the more recently designed runners at a much higher rotational speed than was the case with runners designed a few years ago. This increase in the capacity of runners has been secured without a sacrifice of maximum efficiency and with only a small sacrifice in the efficiency at fractional loads.

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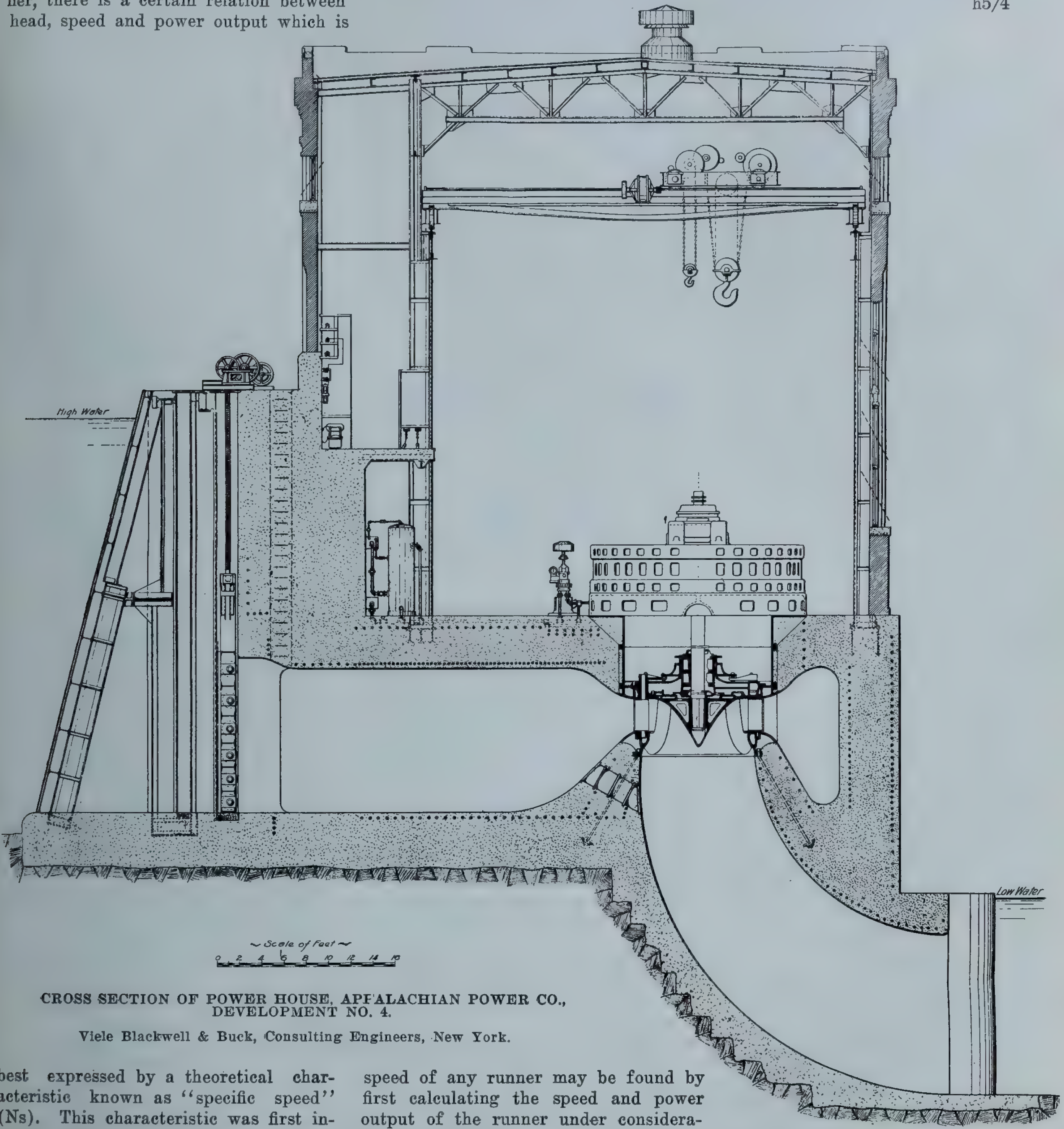
*From paper read before the Mechanical Section of the Canadian Society of Civil Engineers, Montreal, on Jan. 15, 1914.

**Hydraulic Engineer, the I. P. Morris Co., Philadelphia.



CROSS SECTION OF POWER HOUSE, APPALACHIAN POWER CO., DEVELOPMENT NO. 4.

Viele Blackwell & Buck, Consulting Engineers, New York.

In referring to the capacity of a runner, there is a certain relation between head, speed and power output which is best expressed by a theoretical characteristic known as "specific speed" (Ns). This characteristic was first introduced by German engineers. It gives us a means of comparing the relation between the conditions of speed, head and power of a runner in one installation with the same conditions relative to a runner in a totally different installation. This comparison is made after the conditions governing the design of both runners have been reduced to a common base, viz., specific speed.

The specific speed of a runner may be defined as the speed at which any runner will operate when it is reduced to such a size that it will develop one horsepower when operating under a head of unity. The numerical value, expressed in the metric system, of the specific speed of any runner may be found by first calculating the speed and power output of the runner under consideration for one metre head, and then mathematically reducing the runner in size until it will deliver one horse-power. The speed of this reduced runner, when operating at its point of maximum efficiency is its rated specific speed, and this speed is expressed in the formula

$$Ns = RPM \times \frac{\sqrt{HP}}{h5/4}$$

the quantities being expressed in the metric system. For converting this to the foot-pounds system of units, the formula is

$$Ns = 4.45 \times RPM \frac{\sqrt{HP}}{h5/4}$$

in which the horse power and head are expressed in the foot-pounds system, while the Ns remains in the metric system. The specific speed as calculated from this latter formula is the one generally used. In figuring the specific speed of any turbine having more than one runner, the horse-power used in the formula, of course, is the output of each runner.

An examination of the formula will show that for a given r.p.m. and head, the h.p. output is proportional to the square of the specific speed; also that for a given head and h.p., the r.p.m. of a turbine is proportional to the specific speed.

Five years ago, a specific speed of 275 was considered to be quite high, while to-day a specific speed of 400 is secured together with as high a maximum efficiency as was previously secured with a specific speed of 275. Thus, it is now possible with very high efficiency to secure for a given condition of head and power, and with the same maximum efficiency, a speed in the neighborhood of 50% greater than was possible five years ago; or, for a given head and speed, an increase of approximately 100% in the horse-power can be obtained.

With the highest specific speed which could be secured five years ago, the resulting r.p.m. for a vertical shaft, single runner tubine for low heads was, in a great majority of cases, such as to make the cost of both the turbine and generator prohibitive. During the last two years, however, with runners of increased specific speed, a much higher rotational speed can be secured for the same head and power, so that the turbine and generator designs have become thoroughly practical and economical. Although it is true that the rotational speed secured in such a turbine is low when compared with the speed secured with turbines of the same specific speed and having two or more runners, there are many mechanical advantages involved in the use of the single runner vertical turbine for low heads which more than over-balance the increased cost of the generator. The following are among the recent prominent low head plants for which the single runner vertical shaft turbines have been adopted:

Appalachian Power Co., New River, Virginia:

Development No. 2, four 6,000 h.p. units, head 49 feet; speed 116 r.p.m.

Development No. 4, three 3,500 h.p. units, head 34 feet; speed 97 r.p.m.

These turbines hold the highest record of efficiency ever obtained, namely 93.7%.

Mississippi River Power Co., Keokuk, Iowa:

Present installation, fifteen 10,000 h.p. units, head 32 fet, speed 57.7 r.p.m.

Ultimate installation thirty units.

Georgia-Carolina Power Co., Stevens Creek, Georgia:

Present installation, five 3,125 h.p. units, head 27 feet, speed 75 r.p.m. Ultimate installation, ten units.

Alabama Power Co., Lock No. 12, Coosa River, Alabama:

Present installation, four 17,500 h.p. units, head 68 feet, speed 100 r.p.m.

Ultimate installation, six units.

Cedars Rapids Mfg. & Power Co., St. Lawrence River, P.Q.

Present installation, twelve 10,800 h.p. units, head 30 feet, 55.6 r.p.m.

Ultimate installation, eighteen units.

These will be the largest turbines in the world in point of dimensions, and will each weigh approximately 1,250,000 pounds.

Laurentide Company, Grand Mere, P.Q.:

Present installation, six 20,000 h.p. units, head 76 feet, speed 120 r.p.m.

Ultimate installation, ten units.

These will be the highest powered single runner vertical turbines in the world to date.

Northern Ontario Light & Power Co., Cobalt, Ont.

Present installation, two 1,500 h.p. units, head 30 feet, speed 150 r.p.m.

Turners Falls Co., Turners Falls, Mass.

Present installation, three 9,700 h.p. units, head 54 fet, speed 97.3 r.p.m.

Had these plants been built five years ago, it would have been impossible to install vertical shaft single runner units of the same capacity, owing to the low speed and the resultant size of turbines and generators. For the same capacity, it would have been necessary to install turbines with more than one runner, or if single runner vertical shaft turbines were used, the capacity of each would necessarily have been considerably less than that of the turbines adopted, owing to the excessive dimensions with which it would have been necessary to deal.

SUN POWER PLANT AT CAIRO, EGYPT.

MR. FRANK SHUMAN, who is chiefly responsible for the design of the sun system of power production, gave in a recent paper before the Manchester Association of Engineers particulars of the plant erected at Cairo, because that is the nearest place to the tropics easily accessible, though it is not the ideal position for a sun-power plant, being 30° N. The equator would be the ideal position, but up to 20° N. and 20° S., sun-power is considered quite satisfactory. In fact, it has been shown that even at Cairo profitable work can be done by sun-power plants.

General Arrangement.

There steam is generated in improved forms of sun-heat absorbers, of which there are five, each 13 ft. 4 in. wide at the top and 204 ft. long. They are approximate parabolic troughs for catching the sun's rays and concentrating them upon the boiler swung at the focal point. These heat absorbers are placed about 25 ft. apart in the clear, so that they will not shade each other when the sun is low in the morning and late afternoon. Their axis point north and south and they turn from east to west on their axis to face the sun. The mirrors are set in a light steel frame, each one at the proper angle to throw the sun's rays upon the boiler, and consist of ordinary sheets of third quality window glass 1/16 in. thick, silvered on one side, the silvering being protected from the atmosphere. At the focal point of all the light rays there hangs a cast iron boiler, which is tubular at the top and flat at the bottom where is located the water space.

This boiler is 15 in. high, and is hung on light rods in such manner that expansion and contraction will not affect it. The heat absorbers are a distinct advance upon those in use at Philadelphia. They are set on crescent-shaped frames, which roll on a system of small rollers, while racks and pinions are provided for turning the absorbers from a low eastern aspect in the morning to a low western aspect in the evening, the necessary power being provided by the steam engine and friction clutch, an adaptation of the thermostat being used to throw the clutch in and out of gear. The thermostat is placed immediately below the boiler and remains in the shade as long as the absorber points correctly to the sun. When the sun moves ahead a little and the sunlight strikes the thermostat, the clutch is engaged, and the absorber is turned westward accordingly. When the thermostat is shaded again, the clutch is released and the absorbers stand still, and so on.

The Engine Feature.

The engine is of special design to utilize low-pressure steam to the best advantage, and, according to the author, is extremely efficient, giving one brake horse-power per 22 lb. of steam at atmospheric pressure. It has cylinders 36 in. by 36 in., gives its power at 110 revolutions per minute. The pump is of the reciprocating type, and a small petrol engine is provided for creating a vacuum in the condenser for starting. The plant commences to make steam at about 7.30 a.m., in midsummer, and the maximum is reached between ten and two o'clock. The amount gradually decreases until 5.30 p.m. Tests made show that the average production is 1,100 lb. of steam at 15 lb. absolute pressure per hour for a ten-hours' day.

Test Data.

According to comparisons made, the sun-power steam generator will compete in the tropics with a coal-burning steam generating plant which can obtain its coal at only $2.50 per ton delivered to the furnace doors. Any excess in the cost of coal burned beyond this figure is clear profit in favor of the sun-power plant.

Safety Provisions Relative to Transmission Machinery—I.

By W. Sydney Smith.

An official report by the Inspector for Dangerous Trades in England, regarding fencing and safety precautions for transmission machinery, has been issued. It explains the structural and administrative safeguards with regard to the several parts of transmission machinery which experience shows to be needed for the protection of persons employed.

IT is a dangerous fallacy to assume, as is often done, that slow-running shafts, or shafts of large diameter, are free from danger and need not be safeguarded. Every shaft is required by the Factory Acts to be securely fenced, irrespective of its speed or size, unless it be equally safe by position or construction as if it were fenced. Unfenced smooth shafting of 12 ins. in diameter and shafts running at less than 26 revolutions per minute have been responsible for fatalities. The following rules should apply to horizontal, vertical and oblique shafts:—

(1)—Shafts less than 6½ ft. above the floor level should be securely fenced.

(2)—Shafts more than 6½ ft. above the floor level should have those parts securely fenced which are less than 6½ ft. from any point (work bench, platform, shelf, cupboard, machinery, boiler, plant, pile of goods, ladder or other structure, to which workers may need occassional acess for such purposes as lubrication, cleaning, manipulating belts, or other work of maintenance of transmission machinery; lime-washing, painting, electric wiring, cleaning, opening or shutting windows, or any occasional work other than the work of maintenance of transmission machinery, except where the shaft is stopped at the time any worker approaches within 6½ ft. of it, or the shaft is moving at less than six revolutions per minute at the time any worker approaches the transmission machinery for the purpose of adjusting belts, and due provision is made (by signals or otherwise) for prompt stoppage at the first sign of danger.

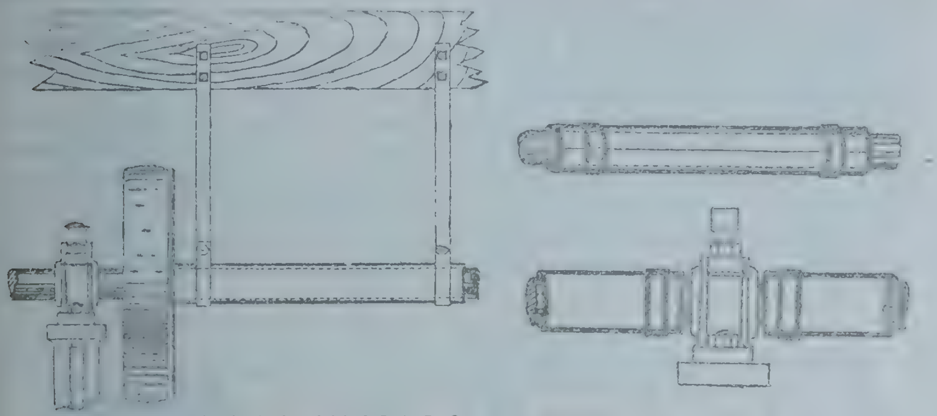


FIG. 1. SHEET METAL OR MILLBOARD TUBES.

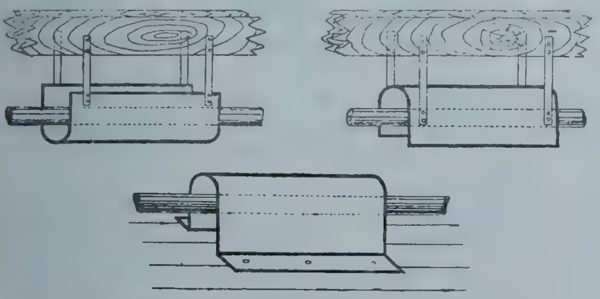


FIG. 2. SHEET METAL TROUGHS FOR PROTECTING REVOLVING SHAFTS.

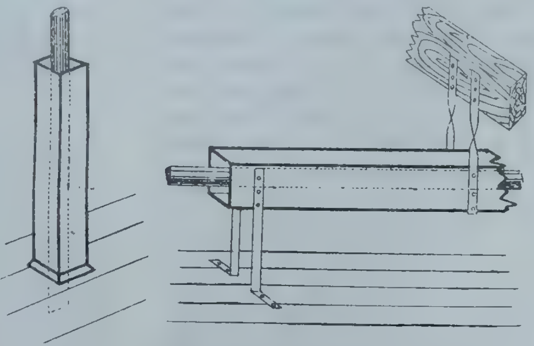


FIG. 3. WOOD CASINGS FOR PROTECTING REVOLVING SHAFTS.

These rules are embodied in the proposed regulations requiring shafting and other parts of the transmission machinery "within reach" to be securely fenced, if in motion, and the phrase "within reach" is defined as meaning "within a distance of 6 ft. 6 ins. in any direction from any spot on which any person employed or working may have to stand or pass at any time, either in the course of his employment or incidentally thereto."

Measurement in an upward direction only will not suffice. Dangerous transmission machinery may be "within reach" in a horizontal or even downward direction from the working place of a person employed—for example, it may be near or below the level of the floor on which he has to stand; or he may have to work at the edge of a pit or on a ladder, with risk of falling into unfenced transmission machinery below.

Although the definition makes no exception for an intervening fence of any kind, even a floor or wall, no difficulty can arise in practice since the requirement of secure fencing may be already met.

Type of Fencing.

The type of fencing needed varies with the position and arrangement of the transmission machinery, but shafts are usually fenced, either by complete or partial casings, consisting of fixed or loose sleeves, or by guard rails so placed as to prevent access. Tubes of sheet metal or mill board, Fig. 1, sheet metal troughs, Fig. 2, and wood casings, Fig. 3, make excellent guards. These may be attached by suitable brackets to such supports as pedestal bearings, hangers, wall-boxes, overhead beams, walls or flooring.

Wire netting is sometimes similarly used, but is less cleanly than complete casings of sheet metal or wood. Millboard tubing, somewhat larger in diameter than the shafting, may be slipped over the shaft as a loose sleeve, which will revolve when the shaft is in motion, but will stop immediately if a person comes in contact with it. Millboard tubes are made of varying lengths, in halves or split on one side. The parts can be readily fastend together by means of thin wire or metal clips which should be free from projections. Loose metal sleeves are often similarly used for fencing shafting and projecting shaft ends.

When shafting is fenced with partial casings, care should be taken that the revolving shaft is covered sufficiently by the casing. Many accidents have occurred on shafts protected on two or three sides, only, leaving the shaft exposed in one or more positions. Shallow partial fencing, such as a trough or single board placed under, over, or adjacent to shafting, is dangerous. For this reason, complete casings are preferable to partial guards unless deep troughs of wood or metal are used.

In some instances, owing to the number of pulleys upon low lines of shafting, as in flour mills, saw mills, engineering factories, and similar works, the shafts cannot be encased. Guard rails are then necessary. The rails should not be too wide apart and the space between shaft and rails, whenever the diameters of the pulleys or the positions of the driving belts permit, should be about 12 inches. If it exceeds this, a person may enter within the space, and if less than this, accidents may happen through contact with the shaft by clothing or materials, or by persons falling against the rails.

In clothing factories, where sewing machines are generally driven by low shafting under the machine benches, the shafts and pulleys are often fenced by rods of iron or by fixed boards, and occasionally by hinged boards. The latter are dngerous, as there is always the chance of the workers throwing back the guard and coming in contact with the shaft. Where rails are used these should be sufficiently strong to resist bending if used as foot rests.

Care is necessary as to position of the guards and spacing of rails and boards to allow, with safety, the adjustment of driving bands and the necessary cleaning under benches, but at the same time to avoid the possibility of the hair being caught. Such accidents generally occur when a worker with loose hair is sweeping under a bench or picking up some object which has fallen on the floor in the vicinity of the shafting. It is usually found either that the guards were fixed originally too far apart, or that a rail had been bent downwards, leaving sufficient space for the head to approach the shaft and the hair to become entangled. A space of 8 inches between the floor and lowest guard, with spaces not exceeding 6 inches between the higher rails or boards, will not interfere with cleaning or manipulation of belts, and will almost entirely remove the risk of accident.

In the latest type of sewing machine benches, the machines are driven from a shaft, fixed a few inches below the bench, and completely encased in planished steel tubing; while the shaft is directly driven by an electric motor co-axial with the shaft. The fronts of the pulleys and bands driving the machines are fenced by cast metal grids. In general, where females are employed, greater care is needed as to the fencing of transmission machinery in order to avoid accidental contact of the worker's hair or clothing with revolving parts; complete encasing of shafting, with protection of pulleys by side plates, as shown in Fig. 1, is preferable.

Whenever it is necessary to cross low lines of shafting fenced by rails, there should be gangways or steps at suitable intervals so as to fence the shaft, with hand rails on either side of these crossing places (Fig 4). Where the shafting is high enough to allow passage underneath, but less than 6½ ft. from the floor level, the shaft should be completely encased at the passage way (Fig. 5).

High shafting in motion must be approached from time to time by engineers, greasers, beltmen and other persons employed in oiling, cleaning, adjusting belts and similar work of maintenance. Where space permits, there should be an overhead gangway or service platform, sufficiently near the shafting to admit of the necessary work being done in safety, and yet at such a distance as to prevent contact with transmission machinery in motion. The platform should have guard rails to a height of 3 ft. and a skirting board to prevent the worker falling under the rails or fall of tools on persons below. Failing overhead gangways, the approach may be made by a safe type of ladder, but in such cases there is always risk of accident unless the shafting in the vicinity be fenced.

High shafts are often permanently encased for about 2 ft. on either side of each bearing, the casings being fixed by suitable brackets to the bearings or hangers. Ladders are sometimes provided with an inverted trough, which rests on the shaft, and so fences the portion temporarily. These may be used where there is ample space between pulleys, couplings and bearings. If there be lubricators, or self-lubricating bearings, oiling can generally be done at rest, but replacing of belts on pulleys is impossible in many cases unless the shafting and pulleys are moving. With various types of belt mounters this operation can be done in safety from the floor level at the ordinary working speed of the shafting.

Where pulleys are close together, fencing of the shaft is often impracticable, and if the worker approaches unfenced transmission machinery in motion to adjust belts, in addition to contact with the revolving shaft, there is always the danger of contact between belt and pulley, or belt and shaft. Hence, in cases where approach to unfenced shafting is necessary, it is imperative that the speed of the shafting be previously reduced to a safe limit.

Severe accidents have occurred on shafting moving at only 9 revolutions per minute, and a fatal accident on a shaft moving at only 5½ revolutions per minute; but a speed not exceeding 6 revolutions per minute may be considered safe for the dangerous operations of manipulating belts by hand on transmission machinery in motion, provided due provision is made by signals or otherwise for prompt stoppage at the first sign of danger.

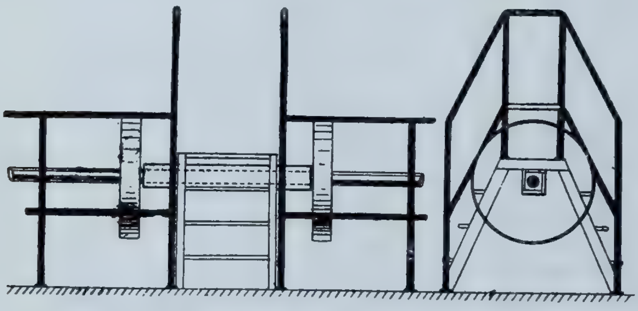


FIG. 4. FENCING FOR LOW SHAFTING WITH STEPS OVER SHAFTS AND HANDRAILS.

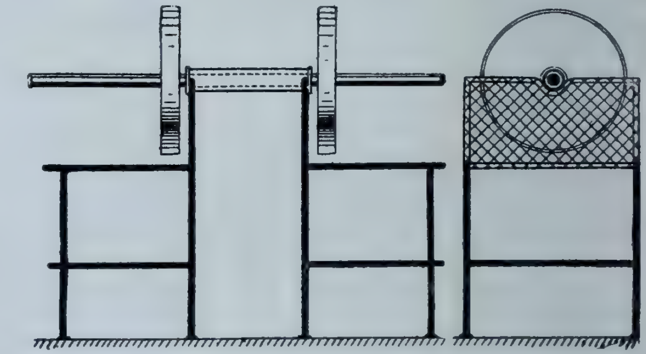
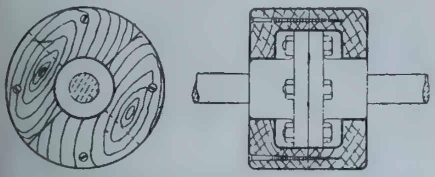


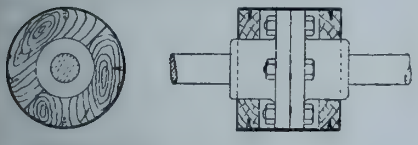
FIG. 5. FENCING FOR SHAFTING WITH FENCED PASSAGE-WAY UNDER SHAFT.

Couplings.

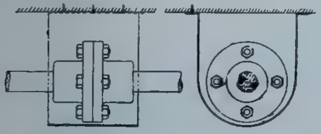
Concerning couplings, the report says that such projections as bolt heads, nuts, screws and keys should be prohibited in all new installations of transmission machinery. Shaft couplings should be constructed with countersunk bolts and nuts, shrouded flanges, or other equally safe devices. In existing installations, as shaft couplings are generally situated near bearings, all pro-



Wood discs in halves screwed together.



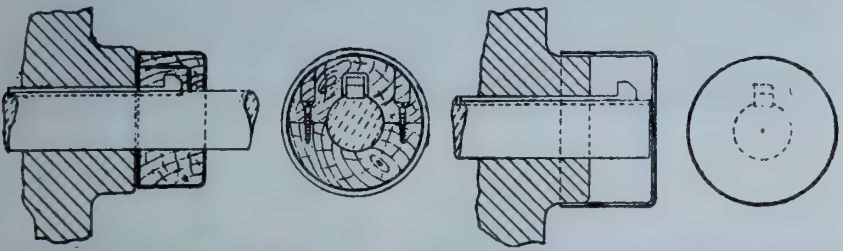
Sheet metal bands screwed to wood discs.



Sheet metal band screwed to ceiling.

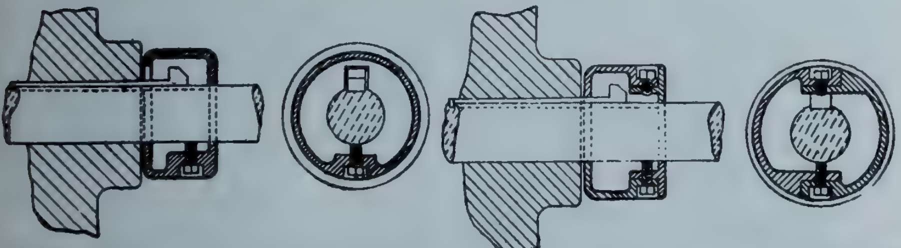
FIG. 6. FENCING FOR PROJECTING BOLTS OF SHAFT COUPLINGS.

jections should be covered by smooth wood or metal casings if the shafting is ever approached whilst in motion. Various methods of fencing projecting coupling bolts as shown in Fig. 6.



WOOD CAP IN HALVES SCREWED TOGETHER.

SHEET METAL CAP ON PULLEY BOSS.



CAST IRON CAP WITH COUNTER-SUNK SCREW.

CAST IRON CAP IN HALVES SECURED WITH COUNTERSUNK SCREWS.

FIG. 7. GUARDS FOR PROJECTING KEY HEADS OF SHAFT COUPLINGS.

Collars.

Projecting set-screws on shaft collars should be prohibited on all new installations. Countersunk set-screws or other equally safe method of attachment should be provided. On existing installations of transmission machinery, as collars are always situated in close proximity to bearings and loose pulleys, projecting set-screws should be removed, replaced by countersunk set-screws, or covered with a smooth cap or guard if the shafting is ever approached whilst in motion. Figs. 8 and 9 show types of guards.

Wheels, Drums, Pulleys.

All appliances of this nature if less

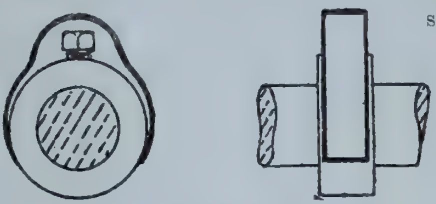


FIG. 8. STEEL CLIP GUARD FOR PROJECTING SET SCREW OF SHAFT COLLAR.

than 6½ ft. from the floor level or any place to which the workers have occasional access, should be fenced so securely as to prevent accidental contact by persons with parts in motion, but appointed persons, such as enginemen, oilers, and beltmen, may be allowed to approach unfenced drums and pulleys for the necessary work of manipulating driving belts and ropes at times when the speed of the shafting and pulleys does not exceed 6 revolutions per minute if adequate provision is made for prompt stoppage of such parts at the first sign of danger. Gear wheels, if situated as above, should be encased with metal guards fully protecting the teeth and rims with a portion of the guard hinged or sliding to facilitate lubrication of the teeth.

Partial guards for gear wheels are always inadequate, and may even be dangerous; though the ingathering teeth may be protected, additional points of danger are introduced between the teeth and the ends of the guard, and fingers, clothing, or cleaning rags may easily be caught unless the teeth are wholly covered. Complete guards, enclosing the whole of the wheels, have the advantage of preventing access of dust and also limit the splashing of grease. For these reasons gear wheels on overhead line shafting are generally completely fenced.

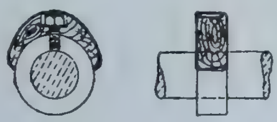


FIG. 9. WOOD GUARD FOR PROJECTING SET SCREW OF SHAFT COLLAR.

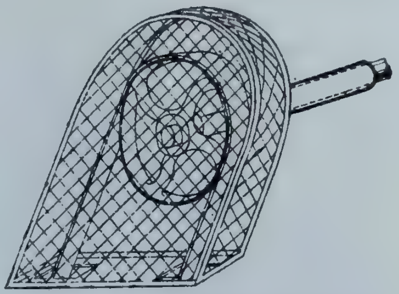


FIG. 10. WIRE NETTING GUARD FOR BELT AND PULLEY.

Sprocket wheels for chain drives should be fenced like gear wheels, if similarly accessible. Friction gearing is equally dangerous as toothed gearing at the intaking parts, but guard rails are generally sufficient for this type of transmission machinery if the fence be maintained in such position that the space between rails and dangerous parts cannot be entered by the workers.

The type of fencing for drums and pulleys is often determined by their position and the direction of the driving bands and ropes; the guards may generally be so arranged as to include fencing for both pulleys and bands, Fig. 10. Fast pulleys near the floor level are dangerous owing to the risk of clothing and feet becoming entangled between belt and pulley. These should be protected by guards, which should also fence the loose pulleys and driving belts. Fenders of wood or metal form satisfactory fences for pulleys in such positions. Guard rails are often so used; sheet metal, wire netting or perforated metal being added according to special circumstances where the pulleys are more exposed or greater danger exists owing to the employment of females.

Engineers Organize. — A meeting of licensed engineers was held on April 18, in the Sons of England hall, Medicine Hat, Alta., for the purpose of forming a local branch of the International Union of Steam and Operating Engineers. There was a good turnout and it was unanimously decided to go ahead with the formation of the branch.

Electrical Driving of Winding Engines and Rolling Mills-II*

By C. Antony Ablett, A.M. Inst. C.E. and H. M. Lyons, A.M.I.E.E.

Each inroad made by electricity into fields long held by the steam engine usually marks a distinct advance in engineering science. The authors show that the electrification of mine hoists and rolling mill machinery is not only fully as feasible as that of railways and other well-known applications, but that it has much greater flexibility in admitting of automatic control, safety devices, etc.

APPLICATION TO ROLLING MILLS.

NEARLY 60 large reversing mills are being driven electrically in different parts of the world, and a modification of the Ward-Leonard system has been installed in almost every case to meet these special requirements.

FIG 7. GENERAL VIEW OF THE ELECTRICAL PLANT FOR DRIVING A [illegible]-INCH REVERSING BLOOMING, ROUGHING AND FINISHING MILL AT THE SKINNINGROVE IRON WORKS. THE 12,000 HORSE-POWER REVERSING MOTOR WILL BE SEEN IN THE BACKGROUND. THE ILGNER MOTOR GENERATOR SET IS IN THE FOREGROUND, CONSISTING OF A THREE-PHASE MOTOR, TWO VARIABLE VOLTAGE DYNAMOS AND A 46-TON FLYWHEEL.

The power requirements of a reversing rolling mill impose much more severe conditions on the electrical plant than those of a large electrically driven hoist. With a large 36-in. or 45-in. blooming mill, ten to twelve passes are often made in a minute, and the power during individual passes may rise to 12,000 h. p. or more, while the total time of the passes, i.e., the total time that the ingot is between the rolls is very short compared with the total time taken to roll an ingot down to a bloom or billet. It is thus easily seen that the average power required from the power station is very much less than the maximum power which the mill motor has to give. For example, in many electrically driven blooming mills, the average power is only one-sixth or one-seventh of the maximum power. The diagrams in Fig. 12, in which the triangular or rectangular spaces show the work done per pass, illustrate how small the average power is, compared with the maximum power which has to be given by the mill motor.

In the case of an electrically driven hoist, the duration of a wind would be perhaps one minute, followed by a pause of 20 seconds or so, and the maximum power required seldom exceeds 3,000 to 4,000 horse-power, so that the average power is of the order of one-third of the maximum power. While, as has already been pointed out, it is frequently necessary to couple flywheels with winding engines it is always necessary to couple a flywheel to the motor generator set which supplies a reversing rolling mill motor, and to make provision so that the motor generator set falls in speed when the mill motor requires a heavy power to enable the flywheel to give up some of its power and then rises in speed again when the mill motor is not requiring power, thereby using the supply of the power house to store up energy in the flywheel. Experience has shown that in a steel works where electrical power is being generated in a blast furnace gas engine power station, the flywheel of the motor generator set has a very beneficial effect in keeping down the cost of this power station.

The flywheel of the motor generator set can be arranged so that it not only reduces fluctuations in the demand of power made by the mill motor to a minimum, but is also capable of reducing or even obviating peaks of short duration in the power demand, which may occur in other parts of the plant which are supplied from this power house. This is particularly the case where direct current power is being supplied. As the blast furnace gas engine has a very small overload capacity, this will obviate the necessity of running extra generating sets in order to take care of the peaks, and it will, therefore, both enable the total installed horse-power of the power house to be kept to a minimum, and will also keep down the running costs.

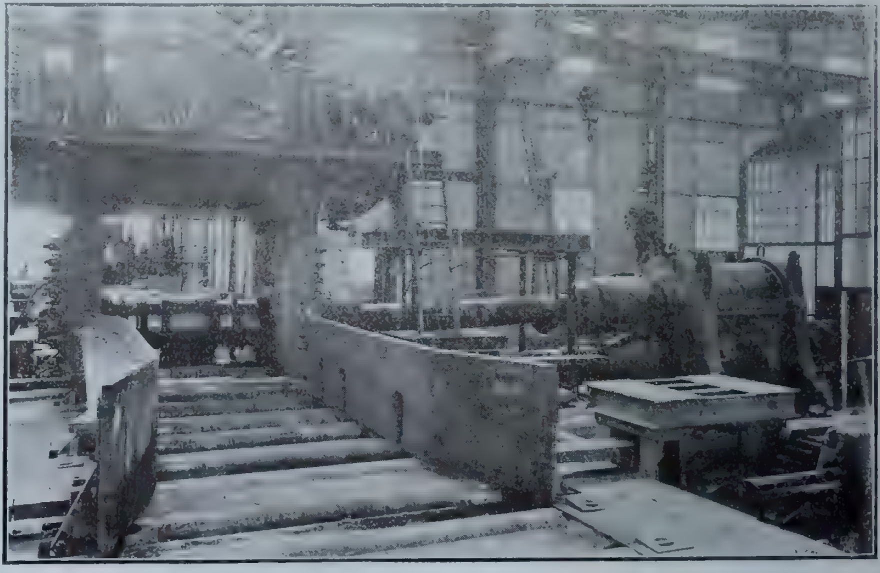


FIG. 8. GENERAL VIEW OF 36 INCH ELECTRICALLY DRIVEN REVERSING BLOOMING MILL AT THE SKINNINGROVE IRON WORKS.

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*Abstract of paper read recently before the Canadian Society of Civil Engineers, Montreal.

A reversing rolling mill motor, on account of the rapidity with which it has to reverse, must be so designed that its moment of inertia is kept down to a minimum and special precautions must be taken to see that the field of the generator supplying this reversing motor should build up as rapidly as possible. This has been accomplished so successfully that it has been found possible to reverse a large reversing mill motor having rotating parts weighing over 70 tons, 30 or 40 times per minute between a speed of 60 revolutions in one direction and 60 revolutions in the other, when no steel is being rolled. Such tests naturally cannot be made while steel is being rolled because it would be quite impossible with the present type of live roller tables to return the ingots to the mill quickly enough, but such tests are useful in showing the very high rate of acceleration of the mill motor which can be obtained, and as a measure of the handiness of the mill.

FIG. 9. A REVERSING ROLLING MILL D.C. MOTOR AT SKINNINGROVE, 12,000 HORSE-POWER, AT 60 R.P.M.; MAXIMUM SPEED, 120 R.P.M. TOTAL WEIGHT ABOUT 200 TONS. WEIGHT OF REVOLVING PARTS. 72 TONS.

Power Diagram for Reversing Blooming Mill.

Under ordinary conditions the power diagrams for each wind of a hoist are identical and can be calculated with considerable exactitude from the conditions of working, but with a rolling mill the power diagrams for each pass vary very greatly from one another, and cannot be calculated with any accuracy, for the following reasons.

During the earlier passes heavy drafts are taken, but the ingot is quite short, consequently large powers are required for very short times; but as the ingot is gradually rolled out to a bloom of considerable length and reduced in section, the drafts are diminished, as the reduction in area must be kept moderate, otherwise the bloom is damaged by the formation of surface cracks, etc., so that during the last passes the necessary power is not very great, but it is required for a considerable time.

During the first two or three passes the ingot still has its tapered shape and the metal is very spongy in character, so that the powers required are not very heavy and are very irregular. By the time that the last passes are taken the bloom has cooled down considerably and while this cooling increases the specific power required, such drafts are taken that the power required for these remains much less than that for the first passes. In a blooming mill the draft in each pass is regulated by screwing down the rolls, which brings in a personal element, so that it does not follow that the power diagrams for the rolling down of successive ingots resemble one another very closely, and in addition, ingots do not always come to the mill at the same temperature, which also brings in variations in the power diagrams for successive ingots.

It will be seen that in the design of the electrical drive for reversing rolling mills, experience and judgment play a larger part than calculation, and in any case a good margin should always be allowed to insure that the mill is not underpowered. Many tests have been carried out on electrically driven reversing mills to obtain data for the work done in rolling the various sections. Experience has shown, however, that such data should always be accepted with caution, for even where tests are made on the same mill, rolling the same material under conditions which are as similar as it is possible to reproduce in practice, considerable differences are found in the work which has to be done in rolling down the ingots, because the slight differences in the speed of rolling, in the time taken between passes, etc., which cannot be avoided in practice, have a considerable effect on the results obtained.

Action of Flywheel.

There is a great difference between the behavior of the flywheel coupled to the motor generator set used for driving a hoist, and that used for driving a rolling mill. In the case of a hoist where the power diagrams for each successive wind are almost identical, and about an equal period elapses between each wind, the flywheel gives up power during a wind and regains it during the interval, thus serving to equalize the power between individual winds and intervals.

In the case of a rolling mill, and particularly a blooming mill, the flywheel has to do a double duty, because, during the first passes made on an ingot, the mill motor has to give a large power for a very short time as the ingot is short, so that the energy consumption during the earlier passes is much less than the energy consumption during the later passes, where, although the power given by the motor is not so great, the ingot has been rolled out to a considerable length, so that a very considerable energy is required per pass. The flywheel, therefore, has to give up energy during the passes and regain it during the interval between passes, and also the flywheel gains energy during the first passes of an ingot and loses energy during the later passes, so that its speed variation has a double period, namely, a short period of about 5 to 10 seconds, corresponding to the partial equalization of power between the pass and interval, and a long period of about 3 minutes corresponding to the equalization of power over the whole time of rolling an ingot.

As the flywheel used in connection with a rolling mill has to equalize the power over a period of three minutes or so, it is usually found that these flywheels are much heavier than those applied to winding engines. The motor generator set for a blooming mill is usually supplied with a flywheel weighing about 40 tons, while a motor generator set provided for a plate mill, or a finishing mill, is generally supplied with a flywheel weighing anything from 60 to 100 tons, depending on the work which has to be done. The motor generator set for supplying hoists or winding engines is generally provided with a flywheel of not more than from 20 to 30 tons. Such flywheels would run at a peripheral speed of about 20,000 ft. per minute, though in some cases this peripheral speed has been considerably increased. A 100-ton wheel running at this speed would have a stored energy of about 300,000,000 foot lbs. or 545,000 horse power seconds, and in falling 20% in speed would give up 108,000,000 foot lbs. or 195,000 horse power seconds. The total work required to roll a 1½ ton ingot to a 4¾ x 4¾ billet is 59,000,000 foot lbs. or 108,000 horse power seconds.

Safety Devices.

The safety devices provided for an electrically driven rolling mill are of a much simpler character than those provided for a hoist, because it is not necescary to provide against the possibility of an overwind or the loaded cage falling to the bottom of the shaft due to the failure of the electric power. It is only necessary to protect the electrical plant and the mill itself against careless handling.

Shell couplings are usually provided to couple the pinion wobblers to the leading spindles to prevent the motor or pinions being shifted from their bedplate by axial thrust due to a broken roll. This feature is usually also introduced into well designed steam driven mills. A circuit breaker is provided in the main circuit between the generator of the motor generator set and the mill motor to cut off the power from the motor in case, through carelessness, an attempt is made to roll a cold ingot, or too great a draft is taken on an ingot, imposing a greater strain on the motor and mill than they were designed for.

The circuit breaker is a protection against broken rolls as well as against damaging the motor, and it must be remembered that many rolls, especially the bottom roll, have a very small factor of safety. Such a circuit breaker would be most objectionable if used with a hoist, as only the prompt application of the brakes would prevent the cage falling in the shaft when the breaker opened, but with a mill, when the circuit breaker acts the motor merely comes promptly to a standstill, and if there is an ingot between the rolls, the mill can be reversed, the circuit breaker put in, the ingot run out of the mill again, and no damage is done. This circuit breaker can either be operated instantaneously by a maximum current cut-out in the main circuit or else opened by a lever under the control of the driver. In the latter case, the field currents in the generator and motor field are reduced to zero before the circuit breaker operates; in practice this hand lever is seldom used.

During the latter passes, when the ingot has been rolled out to a bloom of considerable length, there is time to accelerate the mill to a much higher speed than is possible when rolling a comparatively short ingot, and this is desirable in order to get the work done as quickly as possible, while, as the section has become much reduced and the draft is small, a relatively small turning moment is required. The mill motor is of course accelerated to the maximum speed at which full turning moment is required by increasing the field of the variable voltage generator. The most convenient way of obtaining the additional speed without increasing the size and capital cost of the plant is by decreasing the mill motor field, though of course at the expense of reducing the possible turning moment, which decreases at a faster rate than the speed increases, but which, however, agrees very well with the requirements of the mill. There is always the possibility, however, of too heavy a draft being taken through carelessness when the mill is running at this high speed, causing an overload against which the circuit breaker would not offer proper protection. To prevent this, a relay is provided, which, when it operates, strengthens the motor field to its full value and reduces the motor speed to the maximum at which it can exert its maximum turning moment, thus both reducing the overload and putting the motor in a better position to meet it; but if the overload be still too great for the motor, the circuit breaker will open.

The purpose of the flywheel coupled to the motor generator set, as mentioned above, is to insure that the rolling mill plant takes an average steady power from the power station irrespective of any fluctuations in power the mill may require, but the value of the average steady power depends on the work that the mill is doing, i.e., the output and the section that is being rolled. If the regulating mechanism be set for the maximum average steady power, corresponding to the heaviest work that is done in the mill, and then much lighter work is done, rolling slabs for plates for instance, the power taken will fluctuate considerably, but will not exceed the value of average power for which the regulator has been set.

As this fluctuation may adversely affect the regulation of the power house, means are provided to enable the regulator to maintain a lower value of average steady power, corresponding to the work that is being done. If the regulator be set for this lower value, and heavy work is again done in the mill, the surplus power will be drawn from the flywheel to give the necessary energy, the speed of the motor generator set will sink lower and lower till at last the flywheel, whose store of energy is proportional to the square of its speed, will not be able to supply enough power to drag the billets through the mill and the mill will stall. To prevent this, two colored lamps are provided on the driver's platform to signal the speed of the flywheel. The first one, the caution signal, lights up when the flywheel is about 22% below full speed, to warn the driver that the average power is inadequate to the work he is doing, and the regulator must be set to a higher value. The second, or danger signal, lights when the flywheel is 30% below speed, and warns the driver that if he goes on he will stall the mill.

A good deal of space in this paper has been devoted to description of safety devices but it should not be considered on this account that there is any inherent risk in using such electrical plant, as the safety devices are to protect the plant against damage due to careless handling. The devices applied to steam hoisting engines, and particularly to steam reversing rolling mill engines, are of a much more rudimentary description, and the safety of such steam plants really depends on the skill and experience of the driver. It should be particularly pointed out that the electrically driven reversing mill does not increase in speed as the ingot passes out of the rolls, while the steam engine, unless carefully handled, will race and run away.

Three-High Mills.

The authors have selected the electrically driven blooming mill as an example, and space unfortunately does not permit the discussion of the modification of the Ward-Leonard system to suit the requirements of plate mills and finishing mills. It is, however, important to mention that there is an increasing tendency in Europe to use the Ward-Leonard system for the driving of three high finishing mills, instead of a continuous running motor and flywheel coupled to the mill. The reason for this is that the Ward-Leonard system enables a much greater output to be obtained from the mill, because the bars may be entered at a low enough speed to prevent damage being done, and, as soon as the rolls have gripped the bar, the speed is run up to a maximum and diminished again so that the bar leaves the rolls at a reasonably low speed.

As a 100-lb. rail rolled from a 4½-ton ingot finishes about 90 ft. long and bulb angles and channel often finish 200 ft. long, the saving in time which may be effected can be appreciated, and as this enables the material to be finished much hotter, the work done in rolling, and consequently the cost of power, and reduced. Where a three-high mill is driven on the Ward-Leonard system it is found that there are far fewer broken rolls than when it is coupled to a continuous running motor and flywheel. These advantages are found in Europe to outweigh the increased capital cost of the plant.

REFRIGERATION DEPARTMENT

ECONOMY IN INSULATING PIPING IN ICE PLANTS.

By Geo. F. Becker, Chicago.

BEFORE going into details on the subject of insulation for piping, etc., I want to say a few things about the laying out of pipe lines that are to be covered, because it is in line with the obect of this paper, viz: economy.

It is very frequently the case that insufficient space is allowed around pipes to permit the application of insulating materials of the desired thickness. The result is double the labor cost, and, very often, the insulating material has to be cut away, which is detrimental to its efficiency and also to its life. This can be avoided by the proper arrangement of piping, which costs no more, cuts down the cost of insulation and increases the efficiency.

About twenty-five years ago, it was no easy matter to convince a steam user of the value of insulation. Boiler and engine builders have done much to economize in fuel consumption, manufacturers of insulating materials have made extensive improvements in coverings to produce the highest grade of efficiency combined with durability, so that to-day heat and cold insulating materials are in general use in almost every plant and the cost of running a plant can be cut to a possible minimum.

Object of Insulation.

The object of insulating radiating surfaces is to convey the energy from the boiler to engine or to its destination with a minimum loss of temperature. Where steam boilers and pipes and other surfaces are exposed, condensation rapidly forms, which decreases power, because every time a pound of water condenses after being generated into steam, it represents just so many pounds of water uselessly evaporated in the boiler on which fuel has already been consumed. This condensation can be almost entirely eliminated by the use of proper insulation and the result is more power per unit or pound of coal consumed, also saving of wear and tear on engine, because excessive condensation in cylinders is not alone dangerous but decreases the power which drives the engine.

To determine the loss of fuel through radiation is a simple matter. It is, however, necessary to know the steam pressure and its temperature, and the loss in B.T.U. per minute per degree of difference. The following table will give you this:

Steam pressure:	Temp.	Loss per min.
Hot Water	175 Deg.	4.5
Hot Water	200 Deg.	5.5
5 lbs.	227 Deg.	7
10 lbs.	239 Deg.	7.5
50 lbs.	297 Deg.	10
75 lbs.	319 Deg.	11
100 lbs.	337 Deg.	12
125 lbs.	352 Deg.	13
150 lbs.	365 Deg.	13.5
175 lbs.	377 Deg.	14
225 lbs.	397 Deg.	15
250 lbs.	406 Deg.	15.5

The next important thing to know is the value of your coal. The units of different coals will vary from 8,000 to 12,000 B.T.U. There is a loss, however, on account of insufficient combustion or other reasons, of a goodly percentage, and a conservative estimate is, in net efficiency, 10,000 B.T.U. per pound. With this information at hand, and the number of square feet of surface to be covered with the price you pay for your coal, you can quite easily figure out what you are losing on account of uninsulated heated surfaces by radiation for any given length of time with the following formula:

Multiply the number of square feet of radiating surface by the unit loss per minute according to what steam pressure you are using (as shown in the above table). Multiply this by 60, representing the number of minutes per hour, by the number of hours which the plant runs per day, and by the number of days which the plant runs per year. This will give you the number of units per year. Divide this by 10,000 (the heat units a pound of coal will liberate) and this divided by 2,000 (representing the number of pounds in a ton of coal) will give the number of tons. This multiplied by the price you are paying per ton for coal will give the loss in dollars and cents.

Obviating the Radiation Loss.

Now that you know what your losses are per year, you naturally wish to know what it is possible to save of this loss, therefore, it is only fair to assume that the best insulation will bring the best results. Various material tests have been made by George Barrus, who is very well known; also by Professor Norton of the Massachusetts Institute of Technology. Both have a reputation of high authority on testing of insulating materials. The latter gives the following insulating values for popular brands:

High Pressure.

Asbesto-Sponge Felted covering will save 85 per cent.

85 per cent. Magnesia Coverings will save 83 per cent.

Low Pressure.

Asbestocel Covering will save 77 per cent.

Air Cell Coverings will save 74 per cent.

Moulded Coverings will save 70 per cent.

You now have approximately what you can save of your losses; let us therefore study the following illustration as an example.

We will say that the following pipes are uncovered:

100 ft. of 1 in.
100 ft. of 1½-inch.
100 feet of 2-inch.
100 feet of 2½-inch.
100 feet of 3-inch.
100 feet of 3½-inch.
100 feet of 4-inch.
100 feet of 4½-inch.
100 feet of 5-inch.

This represents a total of 900 lineal feet of pipe, having a radiating surface of 812 square feet; and we will say that the steam pressure is 150 lbs. You are operating 300 days per year, and you are paying $3 per ton of coal. In accordance with the table given the units lost per minute are 13.5.

$$\left\{\frac{812 \times 13.5 \times 60 \times 10 \times 300}{10{,}000} \div 2000\right\} \times 3.00 = \$294 \text{ loss.}$$

By comparing this with the cost of covering for the 900 lineal feet of pipe, the return on the investment can be arrived at. The list price on the measurements given in accordance with the standard pipe covering list, is $526, for 1 in. thick covering. The approximate discount on asbesto-sponge felted covering which includes its application, is approximately 40 per cent. from the above, so that your net cost for insulation would be $255.60; and in accordance with Prof. Norton's tests you can save 85% of the $294, which equals $250,—your net saving per year by the use of covering. Compare this with the cost of covering, and it distinctly shows that a good insulation will save its original cost the first year. The next essential point is durability. If such an insulation will last an indefinite period without loss of efficiency, it will save a clear $250 for many years to come in the consumption of fuel.

This shows conclusively that insulation is a big factor for economy in a plant. From the tables given, it becomes an easy matter for anyone to estimate his losses and the figures will vary in accordance with what you are paying for coal, and if you are operating your plant more than 10 hours per day, and more than 300 days per year, this will naturally increase the saving. It is also essential to cover the exposed parts of boilers, water heaters, feed water lines and exhaust lines. The latter especially if the exhaust is regenerated into steam.

Cold Pipes.

In regard to cold pipe covering, all the various materials on the market are for all practical purposes the equivalent in insulating efficiency. A comparison between the various materials is therefore of no great importance, and it resolves itself into the question of first cost and life. The first important thing is to have the insulating material properly applied. All joints practically should be made air tight to guard against possible leaks. If this be not done, no matter what covering is used, frost forms between the surface of the pipe and the insulating material, which has a tendency to pry off the latter. This is also the case where covering is not of sufficient thickness, and, in such cases it is absolutely impossible to make repairs to such coverings, but a considerable quantity has to be removed and replaced with new material. It is possible to apply insulating material especially adapted for covering cold pipes so that they will give the desired results, but greater care has always got to be taken than is necessary with the application of heat insulation materials. For instance, on cork covering, the joints run straight from the outside of the insulation to the pipe and unless these joints are properly cemented, or the cork material is not thick enough to withstand the temperature, such troubles as before said are likely to occur.

The two most popular insulating materials for covering ice pipe are cork and hair felt. The latter material is very often combined with a sectional covering over hair felt, composed of waterproof materials. Hair felt coverings are always applied in more than one layer and the joints between the different layers carefully broken. These layers of hair felt, or combination covering as stated before, are applied with hot asphalt in connection with water-proof insulating felts with which the joints are carefully sealed, and the same material is applied between the different layers. In such a construction, there is less chance for a leak. I can only repeat that the correct application of any and all materials suitable for cold pipes is most essential.

Another important item before commencing the application of any and all materials suitable for cold pipes coated with ice is to thoroughly remove all frost and ice from the surfaces that are to be covered. This can be done with hot water, if convenient, but only sufficient ice or frost should be removed ahead of the insulation to prevent this formation coming back on the pipe, that is, when the pipe is under service. It is possible with the use of a piece of waste dipped in oil and wiped over the pipe surface where ice has been removed to prevent the frost from coming back on to the pipe quickly. Better results from insulating materials are obtained by shutting down the plant until the insulation has been applied.

The reasons for covering cold pipes are the same as apply to pipes radiating heat, viz.: economy, in both fuel and machinery, and it is imperative that all exposed surfaces that radiate or absorb heat are insulated in an ice making plant, if you wish to cut down the cost of your product. From uncovered cold pipes, especially when the temperature in the room is somewhat high, there is a constant dripping of water which is not alone a nuisance but very often destructive, and, in order to accomplish the highest efficiency, it is necessary that brine lines, suction lines, liquid lines, headers, accumulators, brine coolers, separators, traps and purifiers be well and sufficiently insulated.—From a paper read befor the Illinois Ice Dealers' Association.

* * *

DETERIORATION OF AMMONIA IN COMPRESSION MACHINES.

By A. H. Hutchinson.

It is said by some, if not by all ammonia manufacturers, that it is not possible for deterioration to take place in a compression machine; but most of us know that "foul gases" accumulate in the condenser and must be blown out occasionally, and we also know that there are ammonia losses which cannot be accounted for by leaks, so there must be losses due to deterioration from some cause or other. Personally, I have always taken the ground that there were but two causes for loss of ammonia.

Whenever called upon to investigate the loss of ammonia the first thing I look for is loss through leakage. Quite frequently this solves the trouble, because there are many men running machines who do not appreciate the fact that several small leaks equal one large one, and that leakage of ammonia means increased cost of production, so that the first remedy, and, in my opinion, the most important, is to stop the leaks.

The second loss is that of high pressures. These mean high temperatures. On several plants I have been able to reduce ammonia losses by reducing the suction temperatures, thus decreasing the discharge temperature. The following are some causes of high pressure:

(a).—Warm water. Some times this pressure can be reduced by using a recooler for the liquid as it leaves the condenser, using the condenser water on this re-cooler before it goes to the condenser proper. Sometimes more water will accomplish the desired results.

(b).—Short condenser surface. We are quite apt to try to squeeze a ton or two more out of the plant than was originally contemplated, not realizing that every unit of heat the ammonia absorbs in doing its work must be removed by water on the condenser, thus quite frequently an additional coil of condenser would turn the trick.

(c).—Condensers placed in bad location. Keep them as cool as possible, away from hot boiler or engine room, and influence of the hot sun. Give them plenty of air. This will apply to either atmospheric or double pipe.

There are, in my opinion, three things which might cause what is called deterioration:

(a).—Some chemical in the ammonia heated beyond a given point is turned into a permanent gas.

(b).—Some chemical in the ammonia oil being heated beyond a given point is turned into a permanent gas.

(c).—A combination of chemicals in ammonia and oil being heated beyond a given point is turned into a permanent gas.

It is usually considered that ammonia at 900 deg. F. separates into its constituents, nitrogen and hydrogen, and at a lower temperature a partial separation takes place. Some well known authorities say that temperatures should not exceed 300 deg. F., but from my own experience, I should say that temperatures should not exceed 200 deg. F., and even at that, one should be sure that ammonia is pure and that the right kind of oil is used in the ammonia compressor. In other words, this paper could and may be cut to the following:—

Cause:—Excessive heat, impure ammonia or oil, or all three of them.

Remedy:—Lower temperatures, better ammonia or oil, or all three.—From a paper read recently before the Southern Ice Exchange.

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THE TRANSMISSION PROBLEM.

THE rivalry between the different methods of power transmission reminds one of a very similar competition between naval gun makers and armor manufacturers. Electric transmission, even in its crude state, found many applications in which it proved superior to the line shaft drive. Makers of line shaft attachments, however, got busy, and produced roller and ball bearings, lubricating devices, etc. Belt makers and chain drive men are improving their products and simplifying the methods of application to reduce the cost and increase the safety of operation.

The motor drive has undisputed sway in many situations, particularly in connection with large machines and those whose use is intermittent. The belt drive still has many advantages in a more or less narrowing sphere and the newer chain drives are establishing themselves in fields where they cannot easily be superseded.

The more recent developments in available means of power transmission have made necessary particular study on the part of those intrusted with the devising of drives for different purposes and conditions. In fact the transmission problem is becoming more important and complex. It is one in which poor judgment may be the cause of very serious loss, and in which on the other hand, well advised installations will effect large savings in overhead expense as well as form a source of much comfort, convenience and satisfaction.

* * *

ADVERTISING MISUNDERSTOOD.

AS fire is to the manufacturing processes so is advertising to the commercial side of industry useful, essential and dangerous. It is strange but certainly true that the impression created by an ever present and attractive advertisement will strongly influence the average buyer of machinery in favor of the article thus advocated. He will place the convictions received from the publisher side by side with the results of actual investigation.

Like all other useful means attached to our social economy, this power is sometimes abused or debased to a wrong purpose. About eight years ago there was placed on the market a certain, at the time well-known machine which was introduced, particularly throughout the West, by a most vigorous and well managed advertising campaign. The result is that fully half the middle-sized shops one visits, have at least one of these machines in the attic or the cellar along with the other "has-beens" and their advent and brief existence are now but incidents of memory. This machine could not fulfill the claims set forth for it in the advertisements of its sales agents, and furnishes one of a number of examples that have borne out the statement of one of our greatest teachers of salesmanship, "A judicious and aggressive system of advertising will sell anything."

It must be remembered that an advertisement is a statement made by the man who wishes to sell the machine and that the advertiser is strongly tempted to tell but one side of its story. While statements that are obviously untrue would not be printed by a reputable publisher, still the man who pays for the privilege is entitled to set forth all the peculiar advantages of his product and in such reasonable language as he sees fit.

The purchaser, on the other hand, need not place himself in a position to be defrauded by an advertisement. Reliable manufacturers are satisfied to use the press as a method of introducing their commodities and are willing to demonstrate the value of their products. All others have no place in connection with a business that is run upon careful conservative lines.

Precocious advertising in itself is seldom the real reason for the non-realization of the qualities expected of a new machine. Cheapness of the appliance, and lack of mechanical judgment on the part of the buyer are often the culprits whose sins are charged to misrepresentation.

When machines are bought which do not fulfill the buyers' idea of their necessary qualifications, it should sound a warning note for the manager. The buying department is in the hands of incompetent persons.

THE OPERATORS' VIEWPOINT

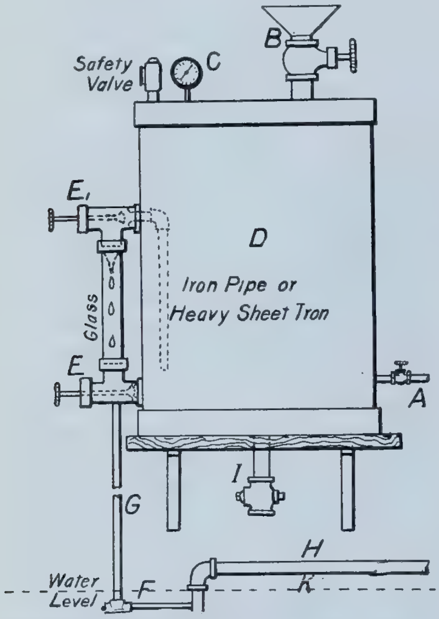
Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

COMPOUND FEEDER WITH NEW POINTS.

By J. E. Noble.

MANY compound feeders have been featured in The Power House at different times, but the one herein described contains one or two new suggestions.

The tank piece (D) may be of large-sized iron pipe, or heavy sheet galvanized iron strongly riveted and soldered, may be used if care be exercised in keeping the pressure well within its capacity. The details consist of a low pressure steam gauge (C), a funnel (B) used to fill the tank (D), a ⅜-in. steam pipe (A) from the boiler, and a stop-cock (I) used for emptying. The whole is placed upon a shelf, as shown. The pump suction pipe is shown at (H), while (K) represents the lowest water level of the supply tank. Fittings (E) and (E_1) were taken from an old sight-feed lubricator. The cock (E) never having to be opened, serves to support the glass. The feed regulation is all accomplished by the cock (E_1).



COMPOUND FEEDER WITH NEW POINTS.

The operation is as follows:—Close all valves except the funnel. Fill the tank with liquid compound and close the funnel valve. Open the valve (A) slightly until a pound or two of pressure is registered by the gauge. Start the feed pump and open the valve (E_1) a little, observing at the same time the speed with which the compound feeds and regulate accordingly. The steam entering at (A) will also serve to keep the solution agitated.

When the mixture becomes weak, draw off some water at (I) and add more compound. At (F) is shown an open tee fitted to the pipe (G) in such a way that if the valve (E_1) be left open and the pump stopped, an overflow will be provided for the excess compound. Normally the pump will draw in the compound along with the water as fast as it is fed.

* * *

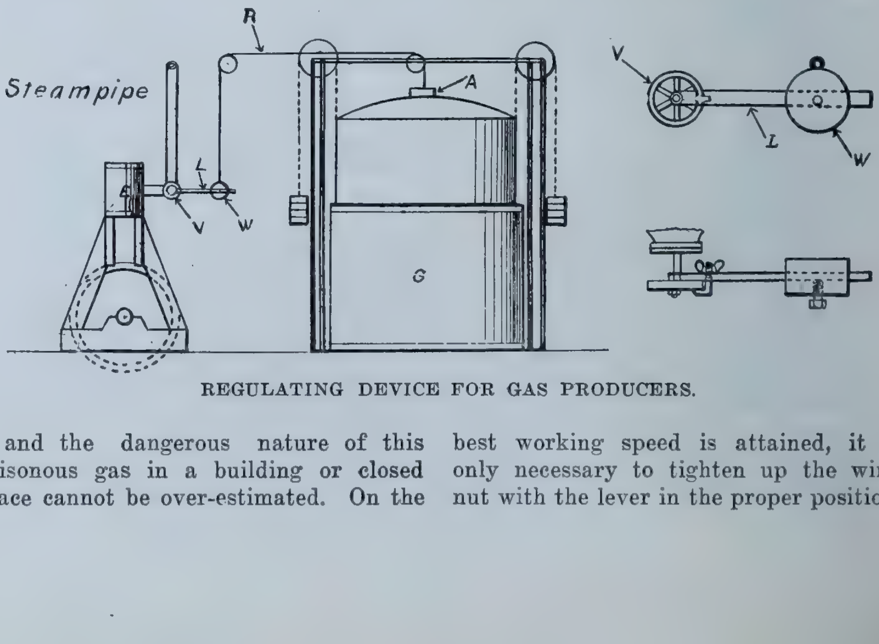
REGULATING DEVICE FOR GAS PRODUCERS.

By R. Bell.

IN connection with gas plants using pressure producers, it is necessary to regulate the speed of the blowers by some means so that the producers supply approximately the amount of gas required by the engines. If this be not done automatically, a constant watch must be kept on the gasometer to prevent it getting too high or too low, especially when a fluctuating load is being carried. If the holder should rise too high, the gas will blow out beneath it and the dangerous nature of this poisonous gas in a building or closed space cannot be over-estimated. On the other hand, I have seen the top of a large gasometer crushed in by the suction of an engine when allowed to go down to the bottom. The accompanying sketch illustrates an extremely simple method of regulation which has been used with great success.

In the above arrangement of the gasometer and blower engine, a lever (L) is attached to the steam valve (V). This lever is connected through the flexible wire rope (R) to a weight (A) on the tank as shown. The counterweight (W) is lighter than (A) but is sufficient to overcome the friction of the valve spindle packing and keep the rope (R) tight. As the holder goes down with a heavy draft of gas, the lever (L) rises, opening the throttle and speeding up the blower engine. Likewise, if the holder rises, the steam is cut off and the blower slows down. The weight (A) is not fastened rigidly to the holder so that there is no danger of breaking the rope by an excessive fall of the gasometer, the weight (A) simply remaining suspended by the cord.

In the second half of the figure is shown the means of fastening the lever to the hand wheel. A hole is drilled in the end of the lever for the valve spindle and another to take the hook bolt clamp as shown. When starting up or slowing down the engine, the lever is disengaged by loosening the wing nut and opening or closing the valve by hand. When the best working speed is attained, it is only necessary to tighten up the wing nut with the lever in the proper position.



REGULATING DEVICE FOR GAS PRODUCERS.

GAS ENGINE TROUBLES.

By W. Stanford.

I WAS interested to read Mr. Grey's query on the above and Mr. Westwood's reply thereto, and would like, if your space permits, to offer a few suggestions. Although not an expert, I have had a good deal of experience with high speed vertical gas engines in England.

The "pounding" that Mr. Grey mentions as occurring at intervals, and which pulls up the engine, is nearly always due to pre-ignition. This was a great trouble to us in our early engines. We found it to be due to too much oil getting past the rings and carbonizing on the top of the piston, and when under full load becoming incandescent. This ignited the charge very early, some 45 degs. in advance of normal, and, of course, shut down the engine in a minute or so. The cure for this trouble lay in two directions, the first being to cut down the amount of oil supplied to the cylinders, and the second to procure a suitable oil. In the engines to which I refer we had seven rings, five at the top and two at the bottom, the duty of the latter being to scrape off the excess of oil thrown up by the connecting rod. This alone was not sufficient if the oil were of too heavy a body.

Not knowing the size of Mr. Grey's engine, I cannot say whether the consumption is heavy or not, but a 200 continuous h.p. engine should not use more than three pints per day of ten hours. Contributory causes may be dirty gas and ineffective cooling, but these come round to the same thing in the end.

I should like to hear further from Mr. Grey in reference to the horse power and the kind of fuel he is using, also whether the lubrication is splash or force.

◆

ENGINEERS SHOULD STUDY COST ACCOUNTING.

By W. W. Pullman.

IN these days when saving and economy are being forced to the front in every line of business it should be to the interests of all engineers to have at least a fair knowledge of systematic cost accounting. Competition everywhere is getting more keen day by day, and manufacturers and owners of plants are looking closely into the question of costs, and where should they naturally investigate more closely than at the power plant, which supplies energy to their establishment. To the manufacturer or plant owner who is on the alert along these lines, the engineer who can render an intelligent and satisfactory account of the cost of running his department will most certainly commend himself for favorable consideration.

Another phase of the question, and one of great importance, is the fact that all over the country isolated steam plants are being replaced by hydro-electric power or power derived from a central station. Sometimes these changes are in the interests of the power user, sometimes they are not. The municipality or company who have power to sell usually have experts on the job, and can show the manufacturer to his satisfaction that they can supply him with energy at a much cheaper rate than he is making it, and there is probably no one sufficiently versed in the conditions of his own power house to give him the exact data in order to refute the assertions. As a consequence, he accepts the offer of central power, whether it be to his advantage or otherwise, and the engineer loses his job.

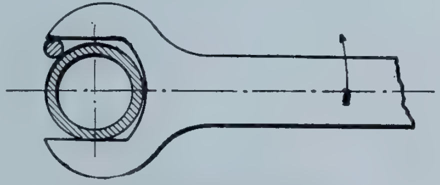
Now, had this engineer been able to have gone intelligently into the matter and demonstrated that, taking all things into consideration, their own production of power was cheapest, he would not only have rendered a service to his employer, but would have retained his position at perhaps increased remuneration.

◆

USEFUL WRENCH KINK.

By G. G. Jackson.

THE sketch shows a simple and effective method of turning a piece of pipe or other round material with an ordinary solid wrench. This is not a new wrinkle by any means, but it will save a great many steps when a pipe wrench is not at hand. Simply place a piece of a small round file between the pipe and wrench as shown and turn in the direction that will tend to jam it in more tightly as the power is applied.



USEFUL WRENCH KINK.

The scheme will not work satisfactorily unless the jaws of the wrench are fairly new and square.

◆

FIGURED OUT.

By. H. W. Benton.

A STUDY of the sketch, and its description as given by R. McLaren on page 132 of April issue of **The Power House**, has sent several lines of thought through my mind. If the designer of this "bag-retarder" has actually been examined and awarded a certificate as a qualified engineer, there is something wrong either with the law or with its application. If there be anywhere in the Dominion of Canada such an outfit in operation, then I am sure it is operated without insurance. I do not know of any boiler insurance company that would allow such a condition to exist. If then the boiler is operated without insurance, where is the factory inspector or the Government boiler inspector that they have not got next to the condition and forced the owners to have it corrected. Personally I do not consider the condition extremely dangerous, that is, I do not consider the boiler liable to explode at any moment as a result of the defect, but it is liable at any moment to give a fireman a very bad scalding; in fact I would positively refuse to operate such an outfit.

There is only one safe and proper way to correct this defect, and that is to cut out the defective material and have a patch riveted on the inside of the shell by a competent boiler maker, and to have the work inspected and passed by the Provincial Government inspector, insurance inspector, or both.

Reason for the "Bag" Formation.

There is a reason for the formation of this bag in the first place. The boiler has been dirty, and the dirt has lodged on the metal where the bag formed. The dirt has kept the water away from the metal; consequently the metal became overheated and the pressure inside the boiler forced the metal out. Once the bag is formed it is impossible to keep mud, scale, etc., from collecting there and consequently the bag will continue to enlarge until a hole is burnt through. The water will then get into the fire and a repair in consequence will become absolutely necessary. In this particular case, however, the engineer has done the boiler maker out of a job, and the expense of the "cure" is only a fraction of the cost of the boiler maker's method, but it is in the same order as all quack medicine; mighty dear stuff in the end, for what this engineer thinks he has, he has not.

Roast for the Engineer.

Mr. McLaren states that the engineer explained that, by opening the valve occasionally, steam was thus allowed to blow through and created such a disturbance in the bag that all mud and undesirable material was blown out. This is about as absurd and impractical an explanation as I have seen placed before the readers of a technical magazine. The fact that a man called an engineer, would install such an apparatus, and then offer such a ridiculous explanation for its justification and accept it himself, is surely good evidence that he should be back in the boiler house, passing coal, instead of in charge of any plant, and further that the laws or combination of laws and conditions that certify such a man as an engineer are a disgrace to the intelligence of all persons interested.

There is in my mind no doubt but that the connection and its use as described by Mr. McLaren does some good; because when the valve is closed steam condenses in the pipe above the valve and fills the riser with water, hence the water in the pipe is higher than the water level in the boiler, and as soon as the valve is opened the water in the pipe will feed into the boiler through the pipe connection into the "bag," until the water in the pipe is level with the water in the boiler. Since the water that can be stored in this pipe above water level of boiler is very small, it follows that the current or circulation that is created by opening the valve is very slight and hence if the engineer should forget or neglect to open the valve frequently, or if mud should collect rapidly in the "bag," there would not be difference of pressure enough to overcome much of a resistance and the scheme would not work. Once the circulation became choked up it would only be a short time until the pipes would burn out and drop out of the bag thus allowing the pressure inside the boiler to force the mud out and of course the water would then follow with such force as to drown out the fire with the attendant possibility of seriously scalding whoever might be near at the time.

I think that drilling the hole into the centre of the "bag" has offset any danger of the sheet tearing, and any enlargement of the bag or overheating would simply release the grip of the threads on the pipe nipple and thus release the connection and allow the water out onto the fire as before stated. I do not, therefore, consider the boiler liable to explode from this defect.

The scheme could easily have been improved by carrying the steam connection up as high as possible before coming down to the valve, say 30 feet if possible, and then fitting a tee instead of the ell under the valve with nipple and valve and drain line to sewer, so that all mud and settlement could be blown out of the "bag" at regular periods as found necessary.

I simply make this statement to show that the engineer did not give the situation any study or else he did not understand the conditions, otherwise he would not have been so boastful of a half-done, half-studied piece of work that in itself speaks so clearly of his ignorance of steam engineering.

The engineer "figures" that he blows the mud out of that "bag" with steam and puts a valve in the line with which to control the steam. **Steam never gets near that "bag,"** and the method of using the valve is his only chance to make the thing work, but it works very different from what he thinks it does.

Suppose no valve was there or the valve were left open all the time: water (in the pipe through the furnace) would be evaporated and would rise up the pipe at front of boiler into steam space and more water would flow down into the pipe through the "bag" to keep up supply of water being evaporated. Thus there would be a circulation of water down through the "bag" into the pipe; this would tend to draw mud into the "bag" and it would only be a short time until pipe and "bag" both would be choked up.

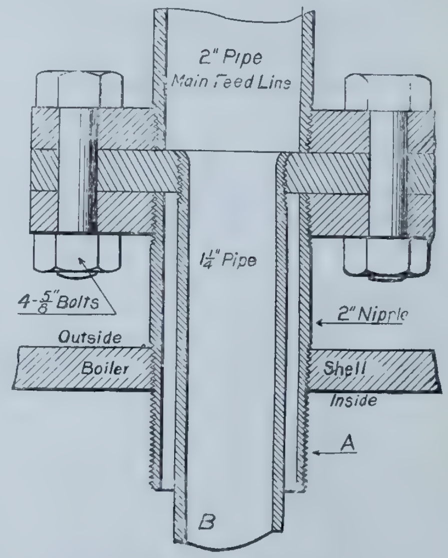
Mr. McLaren deserves a vote of thanks for having this man-trap advertised, and the government inspector ought to be posted as to where this boiler is, so that the affair can be corrected by someone "capable to achieve the desired end of **protection.**" That **engineer** should be saved from himself!

◆

A FEED PIPE KINK.

By F. Cunningham.

OUR boilers are of the horizontal, return-tubular type, and for a long time we had considerable trouble from leakage at the point where the feed pipe entered the shell. No matter how tight the pipe was screwed in, leakage always commenced as soon as the feed pump was started up, due to the difference in temperature between the feed water and the pipe, causing the latter to contract and allow steam to leak past the threads.



A FEED PIPE KINK.

To overcome the difficulty, the feed line was modified as shown in the sketch. A 2-inch nipple was fitted with a flange and screwed into the boiler until it projected about 1½ inches inside. The feed pipe was cut and fitted with a similar flange, and between these two flanges a third was sandwiched which carried the internal feed pipe B. The latter was made of 1¼-inch pipe to allow a steam space between it and the nipple, and thus keep the nipple at a constant temperature.

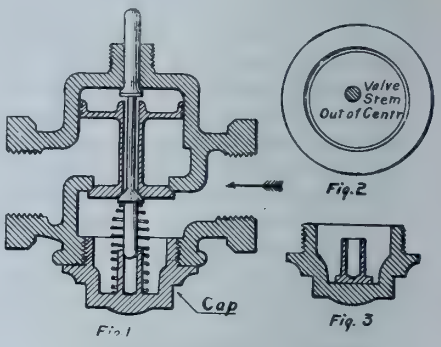
This device proved entirely satisfactory, and we have had no trouble with leakage since it was adopted.

◆

WHISTLE VALVE TROUBLE.

By W. B. Henry.

SOME time ago when taking charge of a plant I was told that the whistle valve was no good, and that the whistle itself was blown by a man opening and closing a 3-in. globe valve while standing on a ladder; the valve being about 14 ft. above the floor.



WHISTLE VALVE TROUBLE.

This particular whistle valve, according to report "was not built properly"—it was "out of line," or had some such defect. All effort, however, to make it work had failed absolutely.

The valve was of the balanced whistle type, and was new, that is, it had been installed but never had worked. It was the product of a very reliable firm, and I could not understand why a new valve of their make could be wrong. An examination was made and sure enough the valve was out of line. With the cap, Fig. 2, removed and the valve pressed firmly to its seat, the valve stem was out of centre just the width of itself as shown in Fig. 2. The valve stem guide in the valve body cap was cast solid with the cap and machined exactly central with the cap; hence the valve stem should be central with the threads in the body where the cap screws on. By screwing on this cap, the valve was held slightly to one side of its seat and could not possibly get there. The valve could be pushed open, but not freely, and if pushed wide open would stick altogether, the spring not being strong enough to force it back again on account of the misalignment of the parts.

The defect was easily overcome, as what follows, together with the illustrations makes abundantly clear. I had the valve cap put in a lathe, and turned out the valve stem guide, leaving the inside of the cap turned smooth and flat. In place of the solid guide I had a self-aligning guide made of the same size as the solid guide, except that on the bottom end a flange was left large enough to have the spring rest, so as to keep this guide pressed firmly against the end of the cap. By this method the valve stem guide moves on the inside of the cap to accommodate the misalignment of the valve parts.

HOISTING AND PORTABLE ENGINEERS ORGANIZE.

WHAT will in future be known as the Queen City Local No. 15, Canadian Association of Stationary, Hoisting and Portable Engineers was duly organized in Toronto on April 27. The objects and composition of the Association are as follows:—

The elevation and maintenance of the rights of the Canadian hoisting and portable engineers, and their recognition by such business interests as their calling warrants.

The Association shall be composed of stationary and hoisting engineers of good moral character, and who are Canadian citizens, and its meetings shall be devoted to the educational, professional and social welfare of its members.

The following officers were appointed and installed:—

President—J. D. Provost.
Vice-Pres.—P. J. Murphy.
Fin. Sec'y—O. J. Hartley.
Rec.-Sec'y—M. Clark.
Treasurer—H. Joyce.
Conductor—A. Warner.
Doorkeeper—A. Dunn.
Trustees—W. Ball, A. Dunn, F. Allen.

Meetings are held in the Victoria Hall, Queen street East, on the first and third Wednesday of each month.

HOW I FIGURE IT OUT?

By John Thorn.

"THE ability to achieve a desired end is more important than passing examinations for certificates." The engineer who wrote the above words in the letter which appeared in the April issue of **The Power House** was right, but surely the freak outfit he described showed no ability, for it certainly will not do the work it is supposed to do, namely, blow the sediment out of a bag in the boiler shell. Furthermore, it is a dangerous outfit.

A moment's thought will show that the steam pressure is less than the pressure it is expected to blow against. There is the steam pressure above the water plus the pressure of the height of the water in the boiler at the hole in the bag. A certain amount of water of condensation will collect in the pipe above the valve and, when it is opened, some of it will run down and enter the boiler until the water in the pipe is at the same level as the water in the boiler. The pipe crossing the furnace above the fire will soon burn out as the heat will force the water out of it, either into the boiler or up the pipe (when the valve is opened for a few seconds at a time). It gets so much heat that a greater pressure will be momentarily generated in it. During the few seconds it is practically empty it will thus become overheated, and as the water rushes back into it a break will likely occur, caused by rapid contraction.

This is the reason feed water pipes cannot be installed in boiler furnaces. To be a success a continuous flow of water must circulate through the pipe. A much better arrangement would be to run the pipe from the bag to a sewer and blow it out frequently. The only sane and safe thing to do, however, is to drive the bag back or cut it out and put in a hard patch just as soon as possible.

That is what would be called reliable ability and good engineering, but the scheme described is poor ability and mighty bad engineering.

READERS' QUERIES.

Soldered Joints for Steam Coils.—Please explain through your columns why solder will not stand up under steam heat and pressure? A short time ago I ordered some heater pipes, which had begun to leak, to be repaired by brazing. The coil rested on the bottom of a drum, and on account of continual rubbing had been worn so thin that it had cracked, causing so much leakage that the pump could not supply the required water to the boilers. When I called at the shop to inspect the brazing job I found it all plastered up with solder. The man who did the job insisted that the soldered job was strictly good practice and fully as good as brazing for this purpose. My experience having taught me otherwise; as the coil is subjected to 100 pounds pressure, I took the job to another shop, where it was brazed without protest. An expression of opinion is wanted as to whether solder will or will not stand up under average steam pressures, and why.—W. Malloch, Belleville, Ont.

Radiator Condensation for Feed Water.—I am trying to induce my employer to utilize, for boiler feed, condensation from steam pans and radiators. He contends, however, that it is injurious to the boiler, in that it sets up galvanic action, and thus causes pitting. Would you please state through your paper whether this is so or not, as I cannot see it his way.—R. V. A.

Safety Valve Springs.—Will you please answer through your columns the question: "What type of stress is set up in the spring of a safety valve in the act of blowing off?" Mr. Swan, the well-known engineer of the steam plant at Britannia Beach, tells me that three marine engineers with first-class certificates claimed that the stress was tensile, and would not agree that it was entirely torsional. The views of Prof. Short differ in other ways from both of these.

Trade Gossip

J. E. Aldred, president of the Cedar Rapids Co., was in Montreal recently and inspected the development work.

The Olympia Hotel, Winnipeg, Man., is being equipped with a 20-ton Arctic refrigerating plant, which was supplied by the Arctic Ice Machine Co., Canton, Ohio.

The Consumers' Ice Co., Winnipeg, Man., have purchased 11,500 feet of piping for their 3,500 ton ice storage house. from the Arctic Ice Machine Co., Canton, Ohio.

The Dominion Steam Heating Co., Toronto, have submitted an application to the Board of Control for permission to install a central heating system for office buildings, etc.

The Crystal Ice Co., Calgary, Alta., are installing a complete 50-ton Arctic Pownall raw water ice-making system, to be equipped with Arctic-Pownall shell brine coolers and operated by a gas engine.

Humboldt, Sask.—The following contracts have been awarded:—(B), Pump house station, Hanson & Paul, $5,120, and foundations for machinery at $8 per cubic yard; (C), Water tower, G. A. Sisson, $12,000; (D), Water pipes and specials, Canadian Allis-Chalmers Co., Ltd., $40.50 per ton for cast iron pipe, $69.25 per ton for special castings; (E), Hydrants and valves, Canadian Allis-Chalmers Co., Ltd., hydrants $46.20 each, steamer nozzles 75c per inch, sprinkling cranes $56.20 each, gate valves 10-inch $35.30 each; 8-inch, $22.30 each; 6-inch, $14.75 each, valve boxes, $14 each; (N), 12-inch wooden pipe, Pacific Coast Wood Pipe Co., 45c per foot, F.O.B. Humboldt; (P), Sewage pumping station, Flanagan & Murphy, $7,900; (X) Sewage disposal works, Flanagan & Murphy, $16,855, pipe laying $2 per foot. The contract for the pumping machinery was not awarded, but the tenders received averaged about $13,000.

Instruction Course for Power Plant Operators--I.

By M. L. Smith, B.A.Sc.

Throughout the writer's experience as a teacher, he has been continually confronted with the query: "Can you recommend a text book for power plant employees?" This, on account of specialization of the different branches of the work and the fact that most books published deal with methods of particular localities, is practically impossible. This series of articles is intended to supply the need, to set forth the technical points so that firemen and engineers can understand and apply them, and be thereby assisted in passing the various qualifying examinations.

INTRODUCTORY.—The qualifications demanded of a stationary engineer who aspires to reach senior rank in his profession cover such a wide field of knowledge and experience that an attempt to include the whole in a single text is difficult. It is necessary, then, that each subject be treated straight to the point and as briefly as possible, which must be done without sacrificing simplicity and ease of comprehension.

It is impossible to prevent the use of a word occasionally, the meaning of which is not perfectly clear to the reader. In this case, a small dictionary will greatly assist to make the course interesting and instructive. To obtain the greatest benefit it is also necessary to have a knowledge of addition, subtraction multiplication and division, as well as lineal measurement or measure of length, square measure or measures of surface, measures of volume or cubic measure and measures of weight and capacity. The lack of space prevents these subjects being included here, but they can easily be mastered with the help of a schoolboy's arithmetic, costing but a few cents.

A few simple problems will be worked out in connection with each article, and it is suggested that these be carefully studied until the principle used in each is thoroughly understood.

Steam Engine.

Definition.—A steam engine is a machine for the changing of heat into mechanical work in which the working substance is steam or water vapor.

Historical Sketch.

The earliest known type of steam engine was a form of reaction turbine, the same in principle as the Parson's, which is being so generally installed at the present time. This was made by Hero of Alexandria in the year 130 B.C., and consisted of a small, round, flat vessel with bent pipes fitted radially. Steam was admitted through one of the pivots and, by blowing out through the bent tubes, forced tubes and all around in the opposite direction, after the manner of the much used rotary lawn sprinkler. Little was accomplished until the 17th century other than the use of steam to operate fountains and toys. An impulse turbine was devised in 1629 which was merely a small water wheel driven by a jet of steam.

Savary.

The first commercially successful engine was built by Savary in 1698. This was a steam pump built on almost the exact lines of the pulsometer of the present time. Steam was admitted to an oval vessel A, Fig. 1, forcing the water out through the check valve B. When the chamber became empty of water, the steam supply was cut off and the steam in the vessel was condensed by a stream of cold water sprayed upon the outside. The vacuum thus formed caused a fresh supply of water to be sucked up through the valve. D. steam was again turned on and the process repeated.

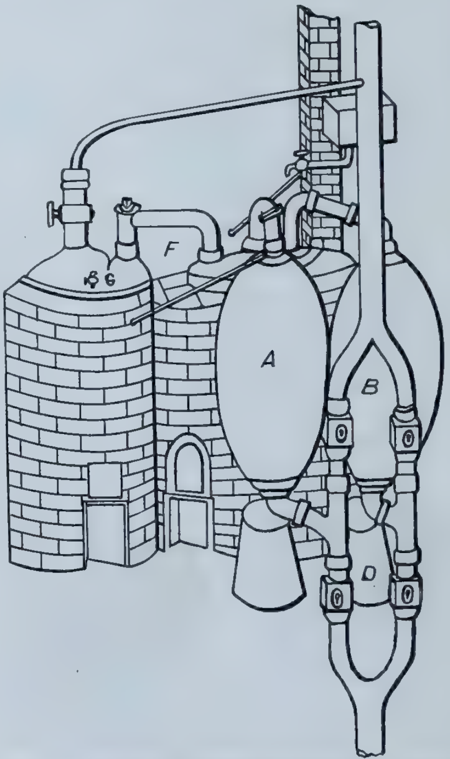


FIG. 1. SAVARY'S PUMPING ENGINE, 1698.

Savary's pumps were built with either one or two chambers very similar to our single and duplex pumps of today, the latter, of course, producing a steadier flow of water. It will be noticed that there are two boilers and furnaces. The one was used to force the feed water into the other. It was first filled with cold water, and by putting a fire under it the water could be forced into the main boiler as desired. A pipe led from the gauge cock to near the bottom of the boiler, so that by opening the cock the operator could tell when the water supply became low.

The height to which water could be pumped depended, of course, upon the steam pressure. Pressures up to 120 and 140 pounds per square inch were carried without safety valves and with boiler and pipe joints made of soft solder and spelter. The most noticeable feature of this engine was the enormous quantity of coal used, being about twenty times that of modern practice. Steam coming into direct contact with cold water and being condensed in the same chamber as used, caused great losses, due to what we now call cylinder condensation.

About this time many attempts were made, principally in France, to produce an internal combustion engine driven by gun powder, but without great success.

Papin.

The next great improvement was made by Dennis Papin in 1690, who put a piston in Savary's engine, Fig. II. This was made of wood, and simply prevented the live steam from pressing directly upon the cold water. Papin seems to have been the first to see the advantages of dry steam. He provided a chamber (D) in the piston to hold a piece of hot iron for the purpose of preventing condensation. Papin also invented the safety valve and the closed air chamber, shown at B.

Newcomen.

In 1705 Newcomen improved the steam engine to the extent shown in Fig. III. Steam entered the cylinder from the boiler, forcing the piston upwards. This was helped by the weight hung on the other end of the beam. The steam in the cylinder was then condensed at first by a stream of water on the outside of the cylinder, but later by a jet of water sprayed inside as shown. The vacuum formed caused the piston to be drawn down and the pump rod attached to the other end of the beam to be raised.

Newcomen's machine was a single-acting engine using very low steam pressures, being worked at times with the manhole of the boiler open. Hence the term "atmospheric engine." The piston was kept covered with water, which not only prevented air leaking past, but by leaking in itself helped to condense the steam.

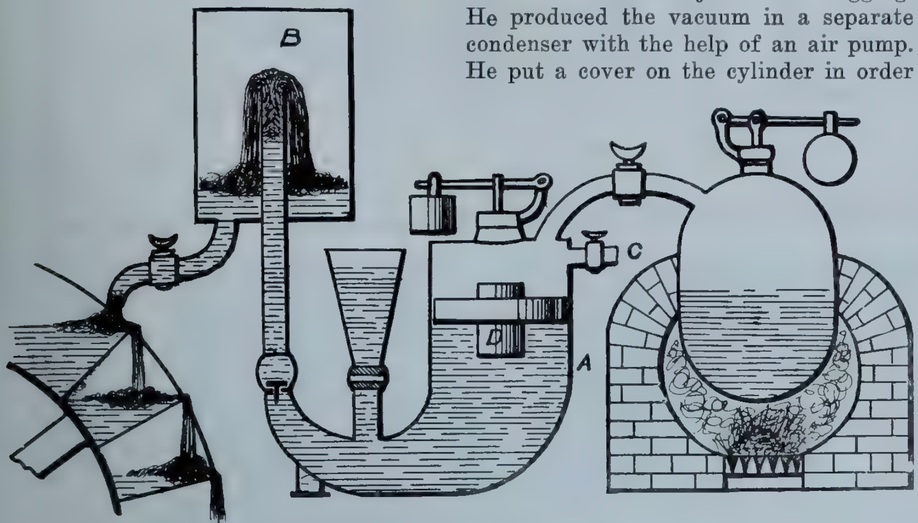


FIG. 2. PAPIN'S PUMPING ENGINE DRIVING WATER WHEEL, 1690. (A), CYLINDER; (C), EXHAUST VALVE; (D), HEATER; (B), AIR CHAMBER.

It is in connection with Newcomen's engine that the story of Humphrey Potter is told. The boy's duty was to operate the valves of an engine at each stroke, but being of an inventive turn of mind, he connected up the valves with cords to the walking beam, thus producing the first automatic valve gear. Newcomen's engine remained practically unchanged for seventy-five years except for some improvements made by John Smeaton. It was used exclusively for pumping water, and, like that of Savary, used a vast amount of coal.

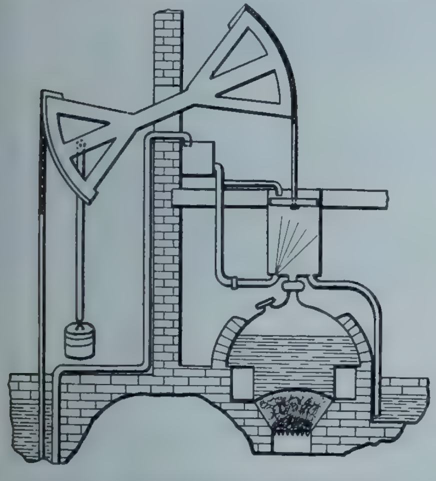


FIG. 3. NEWCOMEN'S ATMOSPHERIC ENGINE, 1705.

James Watt.

By far the greatest improvements to the steam engine were brought about by James Watt, an instrument maker, of Glasgow, who bears much the same relation to the steam engine as Edison does to electricity. While repairing a model of Newcomen's engine, about 1763, he was struck by its enormous loss through condensation in the cylinder. He saw that, to save coal, the cylinder must be kept hot, and to this end added a steam jacket and lagging. He produced the vacuum in a separate condenser with the help of an air pump. He put a cover on the cylinder in order to use steam pressure as well as the suction of a vacuum. The crank being already patented, he devised a gear drive which he called a "sun and planet" motion, and used it until the crank patent expired.

In 1782 Watt brought out a double acting engine in which the steam was used expansively, and from this time forth the steam engine was applied to many other purposes than pumping water. Other inventions of Watt are the throttle valve, the centrifugal governor, the steam engine indicator, and he also settled the value of the horsepower as 33,000 foot pounds.

Throughout his work Watt stuck to low pressures, and fed his boilers through a vertical pipe high enough to allow the water to flow in by its own weight against the boiler pressure.

General Improvements.

The high pressure engine was developed about 1800 by Evans in the United States and Trevithick in England, both of whom used internally fired boilers and devoted their attention to locomotive work. Trevithick was the first to use a steam carriage on a railway. The compound engine was invented in 1781 and greatly improved by Wolf about 1804.

About this time Stephenson began the work that put the locomotive upon a permanent working basis, and in 1829 built the famous engine called the "Rocket," which settled all doubt as to the coming methods of land transportation. This inventor greatly improved the steam blast, built the first tubular boiler, and devised the link motion.

The marine engine in, the meantime, was being developed by Symington, Fulton, Bell and others, and the triple expansion engine became the standard type for marine purposes, but even this has now been largely supplanted by the steam turbine in the hands of C. A. Parsons.

Summary.

Savary invented the pulsometer type of pump.

Papin devised the piston, safety valve, and air chamber.

Newcomen invented the atmospheric engine.

Watt is the inventor of the condenser and air pump, the double acting engine, the use of steam expansively, the throttle valve, centrifugal governor, the indicator, and the horse-power.

Stephenson was the first to use the tubular boiler and the link motion.

* * *

HOW I FIGURE IT OUT?

By W. H. J.

THE device described under the above heading by Robert McLaren in the April number of **The Power House** attracted my attention. Although the steam and water are at the same temperature and pressure, the steam introduced at the bottom of the boiler would doubtless rise in bubbles through the water and thus cause a slight commotion of the water in the "bag." Notwithstanding this, would not a far better result be obtained by piping the "bag" to the delivery line of the feed pump? Of course, I am not suggesting that the whole of the feed should be introduced at this point, but that a pipe should be taken off the main feed line by a "Y" and led to the bulge in the plate. This pipe would, of course, be fitted with a globe valve and check.

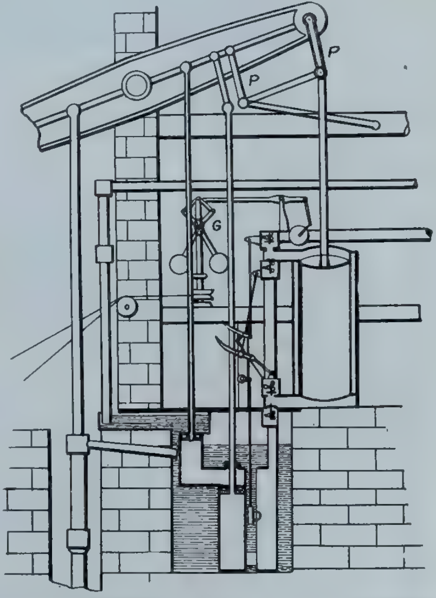


FIG. 4. WATT'S DOUBLE ACTING ENGINE, 1782.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent, practical questions, and give same direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

Question.—A steam boiler 16 feet long and 40 inches in diameter, is made of material ½ inch thick, and carries a pressure of 80 pounds per square inch gauge. What is the stress in the shell-plate?

Answer.—The total pressure tending to disrupt the shell would be the total pressure on the longitudinal cross section, which is $16 \times 12 \times 40 \times 80 = 614400$ pounds.

This pressure is distributed over twice the cross sectional area of the plate, or a surface equal to $16 \times 12 \times 2 \times \frac{1}{2} = 192$ square inches. Stress in shell plate is, therefore, $\frac{614400}{192} = 3{,}200$ lbs. per sq. in.

* * *

Question.—What width of double-ply leather belt would be required to transmit 176 horse-power from a 7-foot pulley at 96 r.p.m.?

Answer.—Using formula

$$w = \frac{H.P. \times 300}{V} \quad \text{In which}$$

w = width of belt in inches.
H.P. = horse-power transmitted.
V = velocity of belt in feet per min.
300 = a constant for double belts.

V = circumference of pulley × r.p.m. or

$$V = \frac{22}{7} \times 7 \times 96 = 2112 \text{ ft. per min.}$$

$$\text{Then } w = \frac{176 \times 300}{2112} = 25 \text{ inches, or}$$

say a 26-inch belt.

* * *

Question.—A motor running at a speed of 600 r.p.m., drives a fan through a counter shaft. A 10 in. pulley on the motor drives to a 28 in. pulley on the countershaft which, in turn drives a 12 in. pulley on the fan from a 56 in. pulley. Find the speed of the fan.

Answer.—Drivers are 10 in. and 56 in.
Driven are 28 in. and 12 in.

Speed of fan, therefore, is

$$\frac{10}{28} \times \frac{56}{12} \times 600 = 1000 \text{ r.p.m.}$$

* * *

Question.—What should be the thickness of a 10 in. cast iron water pipe to carry a steady pressure of 300 pounds per sq. in. Ultimate tensile strength of cast iron 20,000 lbs. per sq. in.

Answer.—Using a factor of safety of 6, the working stress would be $\frac{20{,}000}{6}$

Pressure tending to disrupt pipe is

$$\frac{10 \times 300}{2} = 1500 \text{ pounds.}$$

Area of metal necessary to resist this is $\frac{1500}{20000} \times 6 = .45$ sq. in.

As we are considering a section 1 in. long, the required thickness would therefore be .45 inch.

* * *

Question.—What horse-power boiler would be required for a good Corliss engine of 120 h.p. taking steam at 100 lbs. gauge and with feed water at 200 degs. Fah?

Answer.—An engine of this type would use about 20 pounds of steam per horse-power hour.

One boiler horse-power represents the evaporation of 34.5 pounds of water from and at 212 degs., and to reduce the above conditions to this base the factor of evaporation is used, which for this pressure and feed water temperature is 1.052.

Steam used per hour is $120 \times 20 = 2400$ pounds.

Boiler h.p. required is

$$\frac{2400 \times 1.052}{34.5} = 73.18 \text{ h.p.}$$

* * *

Question.—What would be the weight of water in a cylindrical tank three-quarters filled and of the following dimensions, diameter 20 ft., and height 14 feet.

Answer.—Find volume of ¾ of tank thus:

$$\text{Volume} = \frac{3 \times 22}{4 \times 7} \times 10^2 \times 14 = 3300 \text{ cu.ft.}$$

$$\text{Weight} = 3300 \times 62.5 = 206{,}250 \text{ lbs.}$$

$$\text{or } \frac{206{,}250}{2000} = 103\tfrac{1}{4} \text{ tons.}$$

* * *

Question. — What would be the required diameter of a mild steel piston rod for an engine 24×30 with a maximum steam pressure of 90 pounds per square inch?

Answer.—Maximum load on piston would be area × pressure or,

$$\frac{12^2 \times 22 \times 90}{7} = 40715.1 \text{ pounds.}$$

Allowable working stress is 8,000 pounds per square inch under these conditions.

Area required then is

$$\frac{40715.1}{8000} = 5.0893 \text{ square inches.}$$

Diameter of a shaft of this cross sectional area would be $2\sqrt{a \times \frac{7}{22}} = 2.54$ inches or approximately 2½ inches.

* * *

Question.—Why is it necessary to make the longitudinal seams of a boiler shell twice as strong as the circular seams?

Answer.—Consider a shell 10 inches in diameter sustaining a pressure of 100 pounds per square inch.

Stress on lengthwise seam per inch of length $= \frac{10 \times 100}{20}$ or 500 pounds.

Stress on 1 inch of ring seam is equal to total pressure on shell cross section divided by the length of the seam, or is equal to

$$\frac{3.1416 \times 5^2 \times 100}{10 \times 3.1416} = 250 \text{ pounds.}$$

Which is half that for the longitudinal seam.

* * *

Question.—What would be the approximate mean effective pressure throughout the stroke of a noncondensing engine, the steam pressure being 120 lbs. gauge, the back pressure being 17 lbs (absolute), and the point of real cut off at 1-6 of the stroke.

Answer.—Using formula

$$M.E.P. = \frac{.9P(1+2.3 \log. r)}{r} - .9p$$

In which P = steam pressure absolute or gauge pressure + 14.7 lbs.
r = ratio of expansion.
p = back pressure absolute.
.9 = indicator factor depending on quality or type of the engine. We get

$$\frac{.9 \times 134.7 \times (1+2.3 \times .77815)}{6} - .9 \times 17 =$$

$$\frac{121.23 \times 2.789}{6} - 15.3 = 41 \text{ lbs. sq. in.}$$

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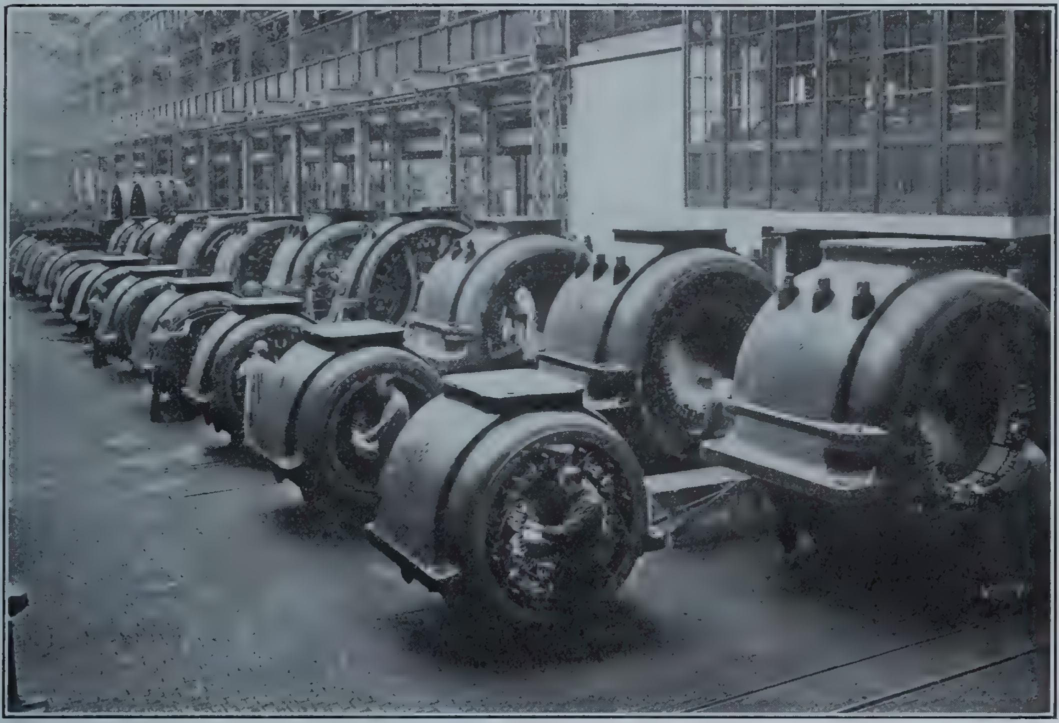


View in one of the Siemens Works showing Winding Department for Stators of Turbo Generator

The following Siemens **Turbo Generators** have been supplied or are on order for Canada:

1—4000 K.W. Edmonton.
1—3000 K.W. Regina.
1—2500 K.W. Dominion Coal Company.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Edmonton.
1—1500 K.W. Regina.
1—1500 K.W. Moose Jaw.
1—1500 K.W. Regina.
1—1200 K.W. Lethbridge.
1— 750 K.W. Nova Scotia Steel & Coal Company.
1— 675 K.W. Medicine Hat.
1— 675 K.W. Medicine Hat.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1—500 K.W. Wayagamack Pulp & Paper Company.

The Siemens Companies manufacture Turbo Generators in single units of 30,000 H.P.

Siemens Company of Canada Limited

HEAD OFFICE:

Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

Arithmetic for the Machinist and Operative-Engineer

By J. H. Rodgers

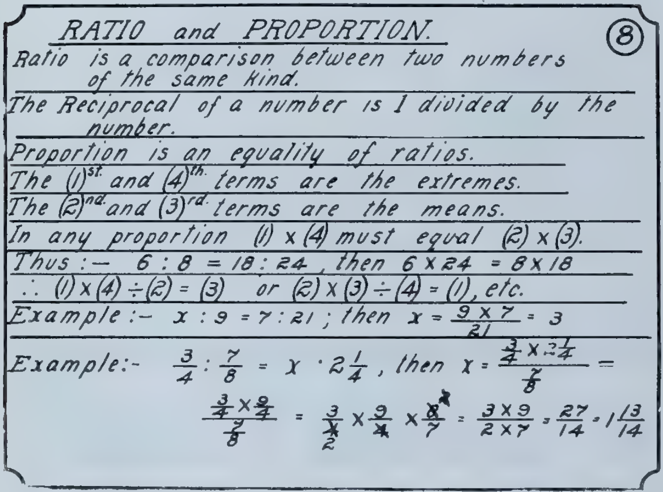
With the further development of this course in arithmetic, it will be found by those who have followed the introductory lessons and profited by them that the various practical applications resulting from the succeeding lessons will be easily observed and their time and labor-saving features so appreciated as to be adopted at every available opportunity.

RATIO AND PROPORTION.

RATIO is the comparison between two numbers of the same denomination, as, 4 is to 8, 120 revolutions is to 180 revolutions, 35 teeth is to 70 teeth; etc. (See Chart 8.) The expression of a ratio is shown in several ways; thus, $3 \div 2$, $3:2$ and $\frac{3}{2}$. That generally used is the second; 3:2, the above ratios being expressed, 4:8, 120 rev.: 180 rev., 35 teeth: 70 teeth, etc. A ratio may be raised to any power, or any root of it may be taken. (See Chart 9).

Proportion (or the rule of three) is one of the most useful sections of mathematics. It is an equality of ratios, indicated by the sign of equality (=). Thus the ratio of 8:6 is equal to the ratio of 24:18, or 8:6=24:18.

Each ratio of a proportion is called a couplet, and each number is called a term. The first and fourth terms are called the extremes, the second and third are known as the means. In any proportion, the product of the means equal the product of the extremes. A direct proportion is one in which both couplets are direct ratios, while an inverse proportion is one which requires one of the couplets to be expressed as an inverse ratio. Such an expression must be changed to a direct proportion by inverting one of the couplets before solution. The principle of all calculations in proportion is that three of the terms are always known; the fourth being required.



RATIO and PROPORTION. ⑧

Ratio is a comparison between two numbers of the same kind.

The Reciprocal of a number is 1 divided by the number.

Proportion is an equality of ratios.

The (1)st. and (4)th. terms are the extremes.

The (2)nd. and (3)rd. terms are the means.

In any proportion (1) x (4) must equal (2) x (3).

Thus :— $6 : 8 = 18 : 24$, then $6 \times 24 = 8 \times 18$

$\therefore (1) \times (4) \div (2) = (3)$ or $(2) \times (3) \div (4) = (1)$, etc.

Example :— $x : 9 = 7 : 21$; then $x = \frac{9 \times 7}{21} = 3$

Example:— $\frac{3}{4} : \frac{7}{8} = x \cdot 2\frac{1}{4}$, then $x = \frac{\frac{3}{4} \times 2\frac{1}{4}}{\frac{7}{8}} = \frac{\frac{3}{4} \times \frac{9}{4}}{\frac{7}{8}} = \frac{3}{\underset{2}{\cancel{4}}} \times \frac{9}{\cancel{4}} \times \frac{\overset{\cancel{2}}{\cancel{8}}}{7} = \frac{3 \times 9}{2 \times 7} = \frac{27}{14} = 1\frac{13}{14}$

ARITHMETIC CHART 8.

The circumferences of two circles vary directly as their diameters, therefore, the circumference of a circle 5 inches in diameter being 15.708 inches; what is the diameter of a circle whose circumference is 23.5 inches?

Expressing the unknown quantity by X, we have

$$5 : x = 15.708 : 23.5,$$

$$\text{Then } X = \frac{5 \times 23.5}{15.708} = 7.48 \text{ inches.}$$

Again, the output of a certain machine being 80 pieces a day; what would be the result if the driving pulley were changed from 15 inches dia. to 18 inches dia.?

$$15 : 18 = 80 : X,$$

$$\text{then } X = \frac{18 \times 80}{15} = \frac{6 \times 16}{1} = 96 \text{ pieces.}$$

In a belt drive, the speed of a certain spindle was 514 revs. per minute. The driving pulleys were 20 in. and 18 in., and the driven pulleys 14 in. and 10 in. diameters. The main shaft has a speed of 200 rev. per minute. Wishing a spindle speed of about 600 rev. per minute, and the only pulleys available being of 20 in. and 12 in. diameter; which one should be used and where, to give the desired result?

The speed of a driven shaft varies directly as the diameter of the driving pulley, or inversely as the diameter of the driven pulley, therefore, the larger the driving pulley, the greater the speed, and vice versa.

Replacing the 18 in. driving pulley with that of 20 in., we get

$$514 : X = 18 : 20$$

$$\text{or } X = \frac{514 \times 20}{18} = \frac{5140}{9} = 571 \text{ revolutions.}$$

Using the 12 in. diameter in place of the 14 in. driven pulley, we have

$$514 : X = 12 : 14 \text{ or } X = \frac{514 \times 14}{12} = \frac{257 \times 7}{3} = \frac{1799}{3} = 599 \text{ revolutions.}$$

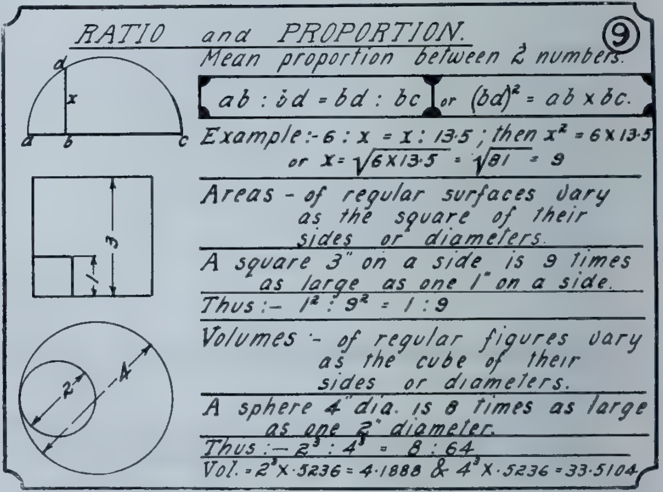
Then by using the 12 in. diameter as a driven pulley in place of the 14 in., we get the required result.

The areas of regular plane surfaces vary as the square of their sides or diameters. (See Chart 9).

A piece of steel 1 in. round, and 4 feet long weighs $10\frac{1}{2}$ lbs.; what is the weight of a bar of 2 in. round and 4 feet long?

$$1^2 : 2^2 = 10\tfrac{1}{2} : X \text{ or } X = \frac{2^2 \times 10\frac{1}{2}}{1^2} = \frac{2 \times 2 \times 10.5}{1 \times 1} = 42 \text{ lbs.}$$

To find the mean proportion between two numbers. (See Chart 9).



RATIO and PROPORTION. ⑨

Mean proportion between 2 numbers.

$ab : bd = bd : bc$ or $(bd)^2 = ab \times bc$.

Example:— $6 : x = x : 13.5$; then $x^2 = 6 \times 13.5$ or $x = \sqrt{6 \times 13.5} = \sqrt{81} = 9$

Areas — of regular surfaces vary as the square of their sides or diameters.

A square 3" on a side is 9 times as large as one 1" on a side.

Thus :— $1^2 : 9^2 = 1 : 9$

Volumes :— of regular figures vary as the cube of their sides or diameters.

A sphere 4" dia. is 8 times as large as one 2" diameter.

Thus :— $2^3 : 4^3 = 8 : 64$

Vol. $= 2^3 \times .5236 = 4.1888$ & $4^3 \times .5236 = 33.5104$

ARITHMETIC CHART 9.

The lesser is to the mean as the mean is to the greater of the two numbers.

What is the mean proportion between 9 and 16?

$$9 : X = X : 16 \text{ or } X \times X = X^2 = 9 \times 16 = 144$$

$$\text{then } X = \sqrt{144} = 12,$$

therefore

$$9 : 12 = 12 : 16.$$

Put Your Factory Equipment Needs Up to

GOODYEAR
TORONTO

Goodyear factory equipment has established a new efficiency standard in large and small manufacturing concerns throughout the Dominion.

Where "price" used to be the basis of purchase in these places, it is now *SERVICE.*

Belting now is bought on *service rendered* and *operating economy effected.* So is Hose. So are Packing and Valves. Manufacturers are buying Goodyear equipment because they know that they can get the very article for the very need—based on an actual investigation and study of the very requirement.

And in buying factory equipment this Goodyear *efficiency service* is yours without extra charge.

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Transmission Belts that deliver all the power without undue strain on the pulleys and "coal pile." Each belt made to meet the very purpose for which it is designed. Each made for "pulling" power—without unnecessary bulk and weight.

"Leg" and "Bucket" Conveyor Belts. For carrying heaviest loads—coal, gravel, ore, grain, etc. Each made with the exact surface for the exact purpose. Carry the load with least wear and tear. Day in and day out utility insures real economy.

Special Brick Conveyor Belt—with oil-resisting stock face. Unaffected by oil that is shed by machine.

Tell Goodyear your belt needs. Learn beforehand of just the belt, *and why.* Then, no after regrets—no after expense.

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Steam Hose, Air Drill Hose, Agricultural Hose, Hose for gas, acids, and hot and cold liquids. Each made with the special inner lining for its particular purpose. Hence, longer life—*greater service.*

Let Goodyear tell you of just the hose you need. Perhaps you have not thought much about it before. But it's a vital matter just the same, if you value time and money saving. Goodyear has already solved just such hose problems as yours.

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Poor packing may serve today—and tomorrow. But it soon gives out. That means lost time—lost motion—expense.

Goodyear Packing gives you a tight joint whether the pressure is air, hot or cold water, or superheated steam. Will not blow out. Unaffected by expansion or contraction. Won't flow under intense heat or pressure.

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Use This Free Service Asking questions about your belting, hose, packing and valve needs, costs you nothing—involves no obligation. The Goodyear Efficiency Bureau will be glad to confer with you at any time. Write today.

THE GOODYEAR TIRE & RUBBER COMPANY OF CANADA, LIMITED

Head Office: Toronto, Ont. **Factory: Bowmanville, Ont.**

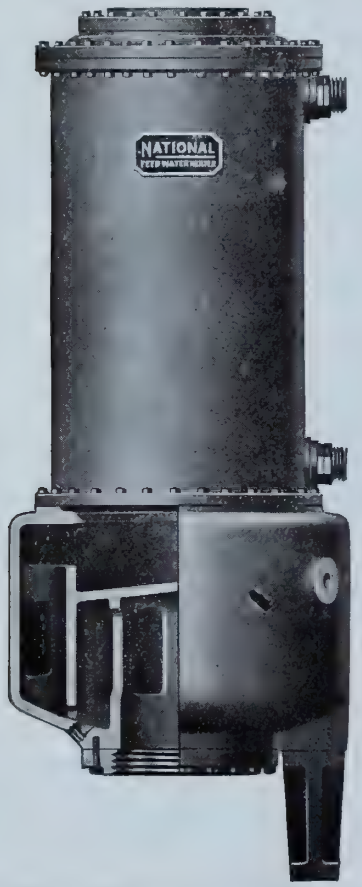
(33)

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

FEED WATER HEATER AND OIL SEPARATOR.

ONE of the recognized advantages of the closed feed water heater is the fact that the feed water is kept entirely free from the exhaust steam, which may contain considerable oil. This type of heater prevents oil getting into the boiler, even if no oil separator is used. When installed, the condensed steam continually leaves the heater through the drip pipe, which should always be left open.



NATIONAL FEED WATER HEATER AND OIL SEPARATOR.

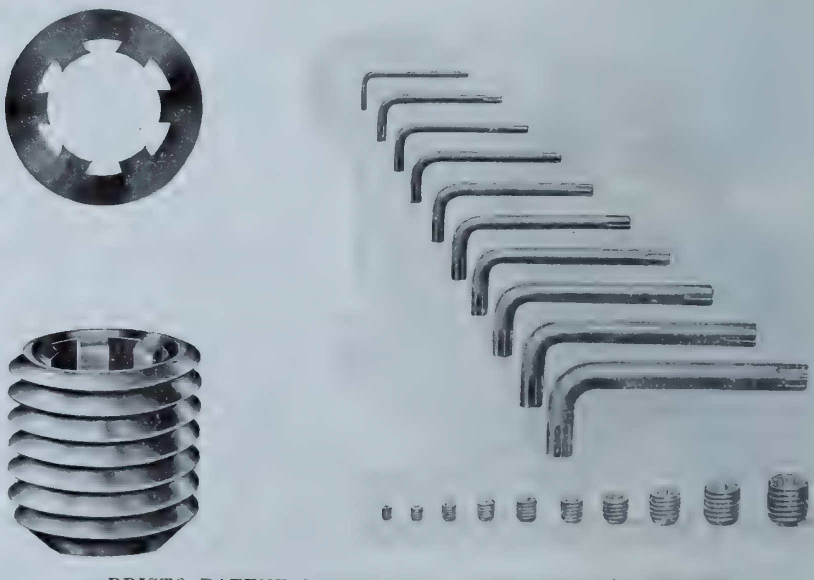
In some installations this condensed steam can be used to advantage in ice making, for washing, or by returning it to the boiler together with drips from a heating system or other apparatus; but the oil must be got rid of, and it is usually easier to take it out of the exhaust steam than to filter it from the condensation.

To facilitate installation, the National Pipe Bending Co. have made a special closed heater, with a separator forming part of it, instead of being detached. The separator is placed at the bottom of the heater, as shown in the accompanying illustration, so that the exhaust steam will impinge upon the baffles and by change of direction and passing through the ports shown, will be freed from particles of oil without adding to the back pressure on the engine. This is accomplished by a very careful design and a slight modification of the company's regular horizontal oil separator, which is distinguished chiefly by the individual baffles and arrangement of ports, having an area of 1½ times greater than that of the inlet pipe.

NEW PATENTED SAFETY SET-SCREWS.

THE Bristol Company, Waterbury, Conn., has recently put on the market a new and improved line of "BRISTO" Patented Safety Set-screws as shown in the accompanying illustration. These are manufactured under the Goodwin patent of October 14, 1913, and the patented design is shown in the cross section, from which it may be seen that there are six dove-tailed slots inside the hollow head of the set-screws, and six corresponding flutes on the outside of the special wrenches used with these. The dovetailed design is such that when the set-screws are set up hard with the special wrench, the latter gives the screw a true rotary motion without the usual tendency to expand and crack the hollow head. The angles of the surfaces of the slots are such that there is just a tendency for the wrench to contract or compress the head of the screw. The screws are manufactured in a great variety of sizes, a few of which are shown. A special treatment process is used which makes the screws glass hard on the outside and extremely tough on the inside, and samples have been found in actual test to be 100 per cent. stronger than the old hexagon style set-screws.

The "Safety First" movement has progressed so far that great attention is now being given to changing the design of machinery to protect human life and the elimination of the old style set-screws with projecting heads is one of the things on which safety engineers and insurance inspectors insist. At the First International Exposition of Safety and Sanitation recently held in New York City, a silver medal was awarded the Bristol Co. for its exhibit of safety set-screws.



BRISTO PATENT SAFETY SET SCREWS AND WRENCHES.

Are your Boilers Safe?

Many serious boiler explosions have occurred shortly after an inspector had reported them in good condition. A superficial inspection is worse than none. It is the duty of every steam plant manager to know the real condition of his boilers.

Scale is responsible for more boiler accidents than all other causes combined, and when its presence is discovered, don't try experiments with patent compound nostrums which require months to learn results, but put a good mechanical cleaner on the job that will show immediate results.

A LIBERTY TUBE CLEANER

will remove all the scale in record time, and at a low cost for upkeep. The hard proposition on which other makes of cleaners have fallen down are what we are looking for.

Write for Catalogue.

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Think of a TWIN when you hear the word STRAINER

The installation of a Twin Strainer on your water supply line eliminates troubles, worry, waste of time and expense—because

It has two straining baskets—that may be cleaned alternately, thus permitting continuous operation.

It has but two valves—they are of the gate type and are always tight.

It gives a direct flow with minimum friction loss, insuring easy operation with no waste of energy.

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Designed to protect and built to last.

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Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves,
Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

Catalogues

Pumps.—The Gray Mfg. & Machine Co., Toronto, Ont., have sent us a copy of a new bulletin No. 12, which describes the steam and power pumps which they make. A full line is dealt with, each type being illustrated together with a brief but comprehensive description.

Air Compressors.—The Canadian Ingersoll-Rand Co., Ltd., Montreal, Que., have sent us a leaflet descriptive of the class "N" compressors which they make. The advantages claimed for this compressor are set forth in a comprehensive manner accompanied by illustrations of other types.

J-M Pipe and Boiler Insulation, catalogue No. 100, deals with the asbestos and magnesia products of the Canadian H. W. Johns-Manville Co., Toronto. A complete line of pipe covering and boiler insulation is illustrated and described. Tables are included giving thickness, weights and prices of sectional pipe coverings, while prices for other products are also given. The catalogue has an attractive cover and a complete index.

Direct Current Generators, small, belted type are described fully in bulletin No. A4188, issued by the Canadian General Electric Co., Ltd., Toronto. The bulletin contains a detailed description of the C.V.C. type of generator, with illustrations showing all the parts disassembled and the belt-tightener attachment. Diagrams are included accompanied by a table giving the principal dimensions and other data for each size of generator.

The C. C. Self-Cleaning Strainer is described fully in a booklet entitled "Protecting the Hearts of Industries," published by the Crane Valve Company, Bridgeport, Conn. The advantages claimed for this strainer are set forth and a sectional view shows clearly the method of application. A table is included giving the prices for the various sizes and another table accompanied by diagrams gives the principal dimensions for each size.

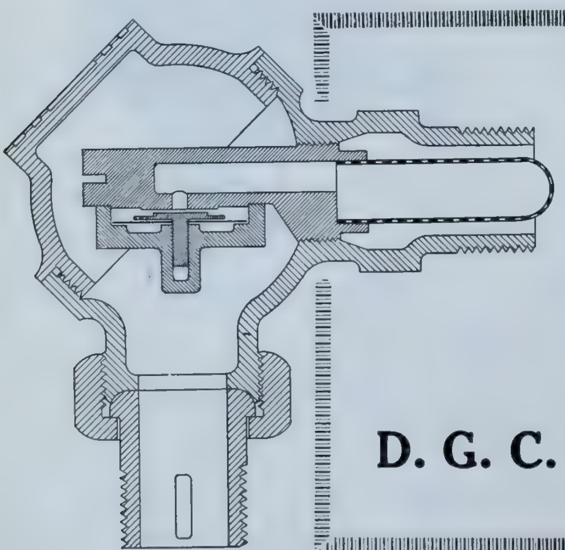
"Grundy" Coupling made by the Canadian Bond Hanger & Coupling Co., Alexandria, Ont., is the subject of leaflet "D," being distributed by the above company. A complete description, with illustrations, is given of the coupling which is of the flexible insulated type for motor drives of all kinds. A table is included giving the prinicipal dimensions of each size and there is also included a useful telegraph code for use when ordering couplings. Copies may be obtained from the Toronto office, 82 Adelaide street, east.

The Grinnell Automatic Sprinkler bulletin for April has come to hand. This bulletin, which is published quarterly by the General Fire Extinguisher Co., New York and Providence, contains photographs of prominent buildings, showing the damage done by fires, with a brief commentary on each. Reference is made to an equipment of "Grinnell" automatic sprinklers on the S.S. "Imperator" and "Vaterland," accompanied by illustrations. A record of fires in buildings equipped with the "Grinnell" sprinkler is given with the loss in each case recorded.

Avery Automatic Scales are described fully in catalogue No. 117, recently issued by the Avery Scale Co., North Milwaukee, Wis. The scales dealt with in this catalogue are principally designed for weighing coal, although some of those described are intended for handling other materials. The principal features embodied in the "Avery" automatic scales are dealt with in a comprehensive manner, accompanied by illustrations of the scales and also of several installations in boiler rooms. The "Avery" patent totalizer is also described and illustrated. On the concluding page is a diagram of an automatic coal scale with a table giving the approximate dimensions for the various sizes. Copies of the catalogue may be obtained from the Canadian agents, Canadian Allis-Chalmers Ltd., Toronto, Ont.

Book Reviews

"Conservation of Coal in Canada" is the title of a report published by the Commission of Conservation appointed by the Dominion Government, and compiled by W. J. Dick, mining engineer of the commission. One striking feature indicated by the report is the dependence of Canada upon the United States for its supply of anthracite coal. This is clearly indicated by means of a map, various sections being colored, to show the origin of coal used in the different areas. It is within the range of possibility that the United States may in the near future prohibit the export of anthracite. Such a situation makes it clear that Canada should husband her coal resources and prevent waste as far as possible. With this in view the report suggests changes in coal mine leases. In addition, it is urged that the government should carry out investigation as to the suitability of low grade coals for use in gas producers and in the manufacture of briquettes for domestic use. Several pages are devoted to descriptions of briquette plants and coke ovens. The greater part of the report, some 163 pages, contains a description of the various mines in the provinces where coal is found, covering such matters as quality, method of mining, equipment, ventilation, etc. The report contains several excellent photographs, tables giving thicknesses of coal seams, diagrams of mine interiors and two folding maps.



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guarantee a perfectly regulated heating system with economy in steam, and no back pressure on the engines.

Unlike all other valves, it has no springs, no floats, no counterweights, no thermostatic plugs, no regulating screws, and NEVER REQUIRES ADJUSTMENT.

It is fool-proof, and cannot get out of order.

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FEED WATER HEATERS
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If you have a water power you can use, the "SAMSON" wheel will develop that power most economically.

The high efficiency shown by this wheel in official tests proves its economy in the use of water, and shows what the wheel will do for you when working under your conditions.

It is easily installed, and when in operation is easily controlled.

The "SAMSON" is always sold on an absolute guarantee.

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There isn't an oil or grease for any service that will not be improved as a lubricant by the addition of Dixon's Flake Graphite.

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Use the **"PREMIER" Die Stock**

It threads one to two-inch right, and one to two-inch left with one set of dies.

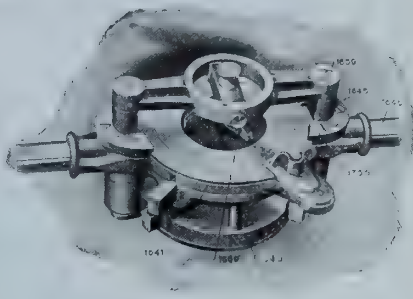
It starts itself on the pipe, also throws itself out after a "Briggs" Standard Thread is cut instead of backing off, which spoils the dies.

The new **Patent Off-set Die** accomplishes, by going over the pipe once, what any other make would do in going over twice, and **does away with leader screws and nuts**—and much trouble.

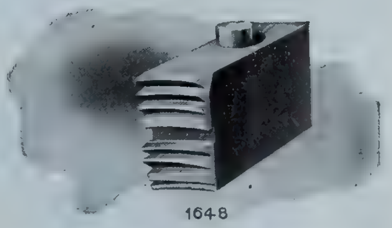
No loose bushings to carry around or lose.

Easily operated. Try it.

Drop a card now for full particulars.



Die Stock Open



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We guarantee an absolute Metal Clean Boiler, when there is sufficient exhaust steam. Get the Nobis habit around your power plant.

Best References

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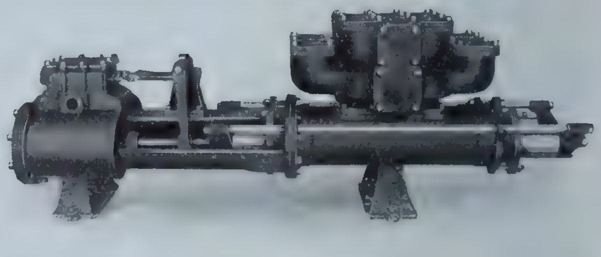

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The freight and duty is the same on **high-grade coal** as on medium or low-grade coal.

Our **Lone Star** slack coal is guaranteed to show 14,000 B.T.U.s regularly.

Our specialty in Canada is high-grade coal from Kentucky and West Virginia via Detroit.

Let us have your inquiries, and call on us if in need of **prompt shipment** via Buffalo, Car Ferry or Detroit.

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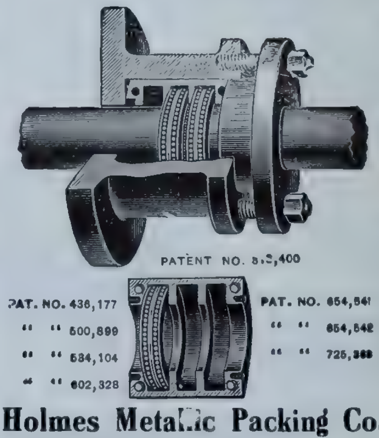

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Metallic Packing

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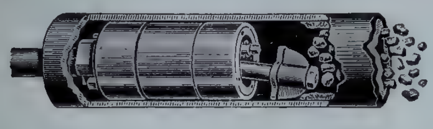
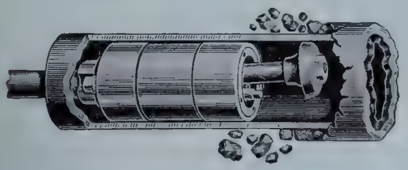
Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.



The Dean removing scale from the tube of a water-tube boiler.



The Dean removing scale from the tube of a return-tubular boiler.

The Dean Boiler Tube Cleaner cut down the operating expense of a boiler plant over 25%.

By removing the scale—not some, but all of it—from the tubes it removed the cause of big fuel bills, loss of power and leaky and burned-out tubes.

We have a very interesting booklet describing this wonderful result-producer.

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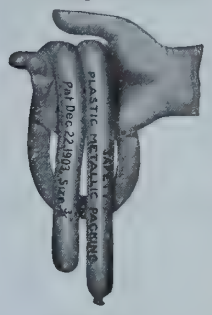

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FOR STEAM, WATER, AIR, GAS, ETC.
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.
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Any Quantity sent on APPROVAL

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Bare and Insulated Electric Wire

Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

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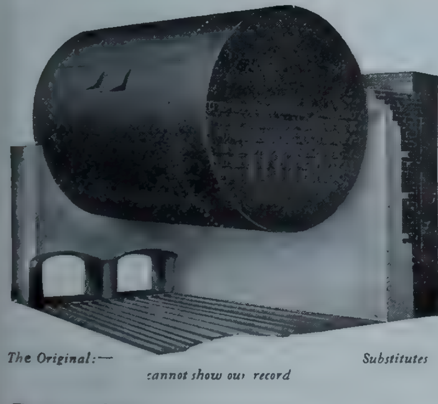

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Door Arches and Whole Front in one block.
Side Wall, or Both in one block.
Bridge Wall in one block.
These linings do not expand or contract and there are no bricks or mortar joints to work loose.
They are readily installed by anyone and require no special molds or forms.
Let us tell you how.

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This mark—

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Lubriko
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stands for better lubrication, at less cost; less wear on bearings and more power transmitted; because—it stands for Lubriko.

And Lubriko is the name of a COMPRESSION CUP GREASE of high flash-point and low cohesiveness—one that under any circumstances, whatever, will not gum.

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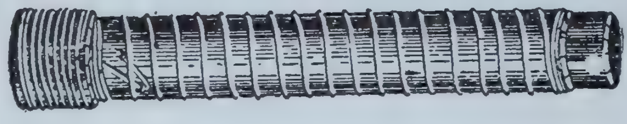

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WATERPIPES and TANKS

For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

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Full Particulars and Estimates Furnished

All Morris Chain-Blocks are

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THE SAME DAY

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649 IN STOCK.

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THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

This Company makes a specialty of Boiler inspection and reporting on their condition.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
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TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

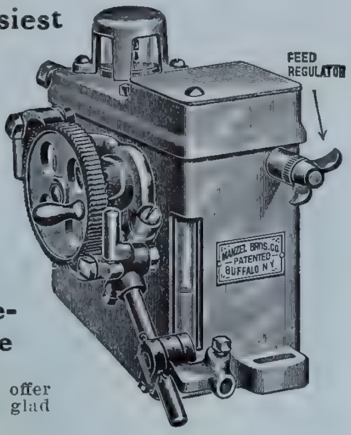
In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

A. KASTELLA
Executive Secretary
STRATFORD, - - - ONTARIO

Free Trial!

It must **REDUCE YOUR OIL BILLS 50%,** prevent wear and tear on your engine cylinders, and prove most convenient, economical and easiest to operate, and save time.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MANZEL BROS. CO. PATENTED BUFFALO N.Y.

If you find the **MANZEL** Sight Feed Oil Pump not doing all this at the end of a month return it at our expense

Take advantage of this offer now—and you'll soon be glad you did.

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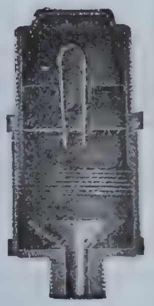
WHY USE OIL

When GREASE Gives More Uniform Lubrication, Is Better and Much Cheaper?



This Grease Cup will pay for itself many times over with the money it saves in lubricants.

You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

The efficiency of this Grease Cup cannot be affected by centrifugal force when used on loose pulleys.

REMEMBER we guarantee it to save 50% over any other system.

Give it a trial and be convinced.

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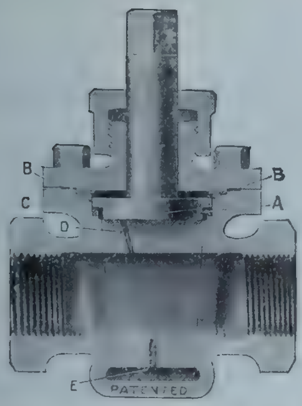

A Guaranteed Valve

For Every Purpose

Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

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Homestead Valve Mfg. Co.
Works: Homestead, Pa. Pittsburgh, Pa.

There Are Over 800 Otis Heaters in Buffalo Alone

EXHAUST INLET EXHAUST OUTLET
OTIS TUBULAR HEATER STEWART HEATER CO. BUFFALO N.Y.
COOL SETTLING CHAMBER

Throughout the various states, thousands upon thousands of horse-power are in use.

Why this popularity?

Because Otis Heaters occupy a place in the engineering world that is second to none.

It is the only pressure heater made that contains an effective oil separator and cool settling chamber.

The exhaust is the heating agent, and 212° is the ordinary, not the spasmodic, temperature of the water.

The Otis has unusually large capacity and heating surface, and is tested under 200 lbs. hydrostatic pressure.

There's a "rock-ribbed" guarantee that covers every function and part of the Otis Heater.

Try it for 30 days at our expense. You have nothing to lose, and much to gain.

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Stewart Heater Company
189 Norfolk Ave., Buffalo, N.Y.

Don't Guess Any More!

With this instrument you can accurately count the revolutions of any revolving part.

For speed tests on engines, generators, turbines, or any machinery, nothing is so reliable and accurate as the

Starrett Speed Indicator

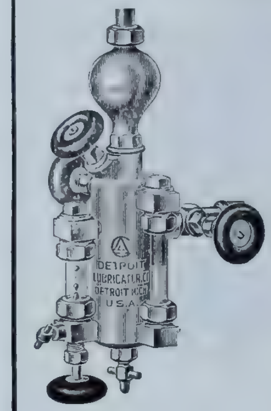
It indicates the highest speed without heating. Small and convenient. Three styles—$1.00, $1.50, and $3.00.

Send for free catalog No. 20 CD *and see what style you need.*

The L. S. Starrett Co.
World's Greatest Toolmakers
Athol, Mass.

Detroit Lubricators for every purpose

The Detroit line includes lubricators for service with every type of steam or gas engine, air compressor or machinery of any kind. One of these lubricators will enable you to eliminate every element of chance or uncertainty from the lubrication of your machine.



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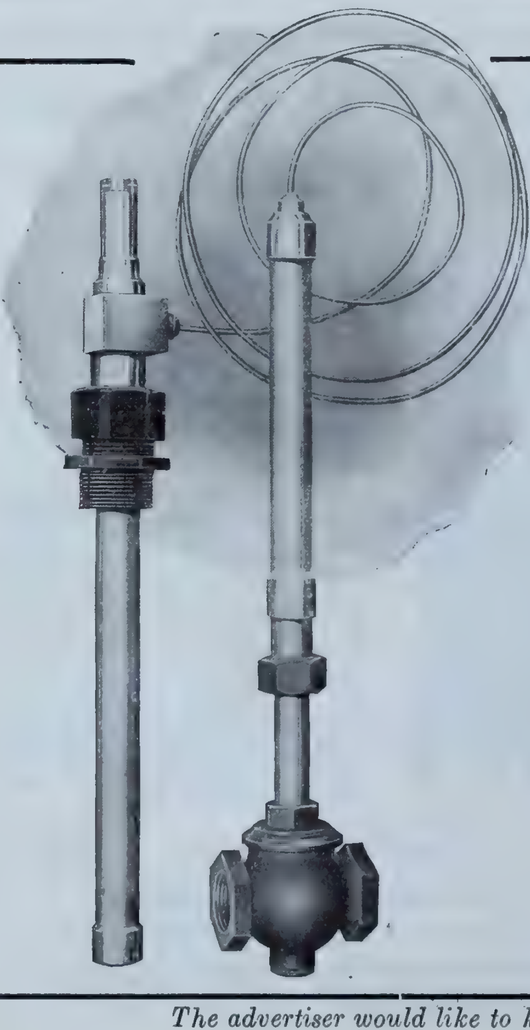
The big Detroit catalog tells about all the different kinds of Detroit Lubricators and gives valuable information on the lubrication of all kinds of machinery.

Write to-day for catalog G-58.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.



Slight Temperature Variations May Mean Heavy Losses

in many delicate manufacturing processes. If such a process is involved in the making of your product, you realize how vitally important it is that your thermostatic regulator should be absolutely accurate.

"SARCO"

Water Temperature Regulators

Are Good Insurance

against such losses.

Sarco Regulators depend for their action upon a principle that is absolutely positive and unchanging. The action of the thermostatic element depends on the expansion of a sensitive liquid hermetically sealed within a chamber. Into this chamber is inserted a flexible corrugated tube connected with valve-operating mechanism controlling steam or hot water inlet, according to the temperature in the tank or room.

No leaky air-valves, perishable rubber or leather diaphragms, or variable metal disc diaphragms are used in the Sarco. Sarco-Regulators are exceedingly simple and cannot get out of order.

Let us send you a bulletin with diagrams and descriptions of this instrument. Write for it.

We also sell "Sarco" Steam Traps, "Sarco" Smoke Recorders and "Sarco" Automatic Combustion Recorders. Bulletins sent on request.

PEACOCK BROTHERS
Montreal

PEACOCK BROTHERS
Vancouver, B.C.

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Winnipeg, Man.

"DROP AROUND—

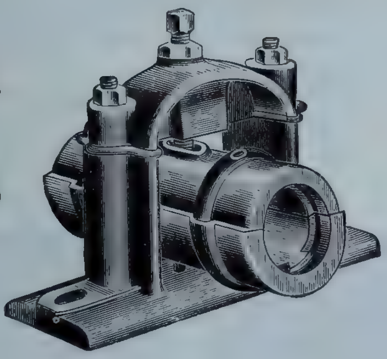
and see us, next Sunday, Bill," says a fellow engineer. And you are on the point of accepting, because you would like very much to go; when you remember—and you shake your head: "Sorry, old man, I can't, I've got to open up the boilers; there's any amount of scale in them; I can't get any steam! And I guess it will take me all Sunday to fix them."

A wasted Sunday and a lot of hard work! All of which could have been prevented by dosing your feed-water with WALKER'S ELECTRIC BOILER COMPOUND.

Think this next time—and meanwhile get our catalogue of Steam Users' Supplies.

The Electric Boiler Compound
COMPANY, LIMITED
Guelph, Ontario

What users say



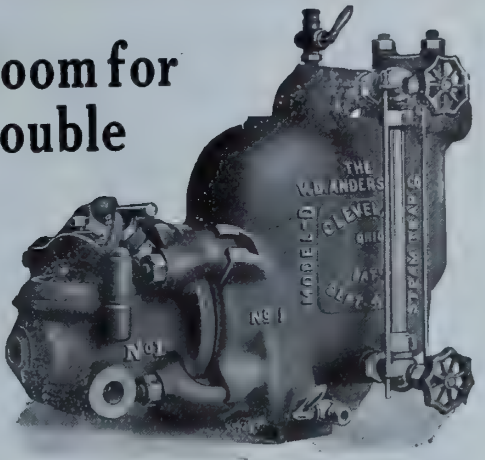
about Bond products, is a better advertisement than we can pen ourselves.

And this is because they've found Bond Specialties up to specification, because they've got no "transmission kicks" coming.

Join this "no worry" brigade—now, and send for our catalogue.

Canadian Bond Hanger & Coupling Co., Ltd.
ALEXANDRIA, ONT.
Toronto Office 82 Adelaide Street East
Main 6519

No Room for Trouble



in your heating system if you use the

Anderson
Model "D" Steam Trap

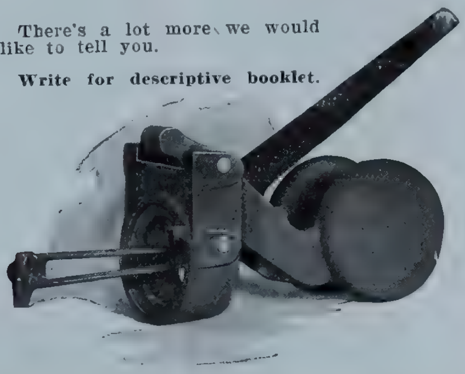
IT IS A CONTINUOUS, RELIABLE AND STEADY DRAINER, which disposes of the condensation as fast as it accumulates, without permitting live steam to escape.

The Valve and Valve Seat can easily be changed from high to low pressure, or vice versa, in five minutes, without disturbing or unscrewing a single joint or pipe connection. We supply Valves and Valve Seats for any pressure.

THE CUT BELOW SHOWS THE COMPLETE WORKING MECHANISM OF A MODEL "D" TRAP, consisting of Hanger, Float Lever, Counter Weight, and Valve Connection assembled ready to fit into its place on the head. These assembled parts are very accurately built, and fitted up with just the right amount of play to allow the expansion and insure free-working.

There's a lot more we would like to tell you.

Write for descriptive booklet.



The V. D. Anderson Co.
West 96th St., Cleveland, Ohio

BRANCH OFFICES: 330 Manhattan Building, Chicago, Ill.; 6047 Jenkins Arcade, Pittsburg, Pa.; 3 Arch St., Philadelphia, Pa.; 212 Walnut St., Cincinnati, Ohio; 207 Union Trust Bldg., Baltimore, Md.; 85 High Street, Boston, Mass.

SUNDAY MONDAY SATURDAY

3

10

17

24

31

2

30

Spending Sundays in a Boiler?

Are you one of the many engineers who are forced to work on Sunday in order to keep your boilers free from scale? There was a time when the old method of "digging-out" scale was a necessity. Times have changed. Scale can now be removed and prevented by treating the feed water with

McColl's Special Boiler Compounds

or Feed Water Treatment

A small quantity of this treatment used daily in your feed water will keep your boilers as clean as a pin and save you many hours of dirty, unpleasant work. **Let us give you full particulars about this Boiler Compound. It's like our oils, best by test.**

We treat each case thoroughly and individually, and guarantee good results.

McCOLL BROS. & COMPANY
WINNIPEG
MONTREAL TORONTO
and VANCOUVER

Electric Boiler Scale Picking Machine, Devoorde Patent

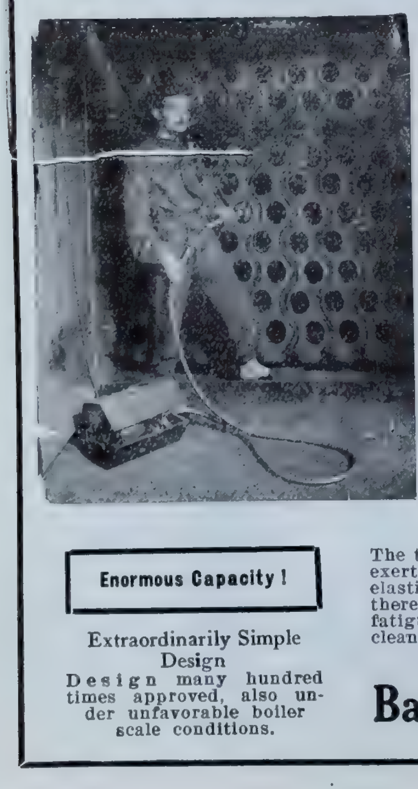
Type F: For Fire-tube Boilers, etc., also for Picking the Grates Crusts, etc. For Cleaning Ship's Skins and for Sharpening Millstones.

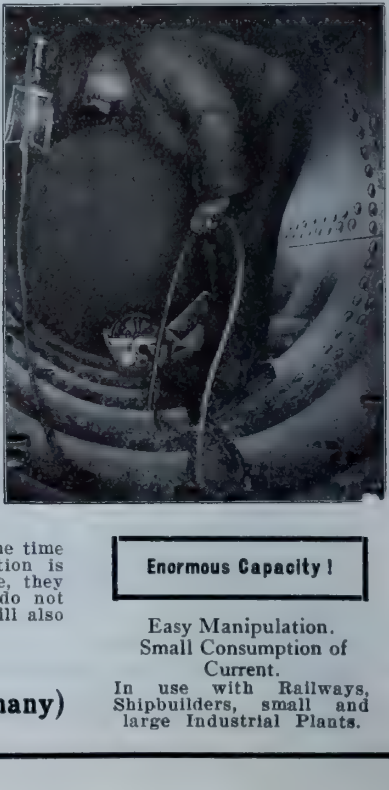
Type R: For Cleaning the Tubes of Watertube Boilers, Steep-tube Boilers, Economizers, Vacuum Apparatus, etc. (also suited for narrow and slightly curved tubes).

Type C: Combined installation.

Splendid Testimonials at Disposal! Great Advantages!

Approved where other Types Failed





Enormous Capacity!

Extraordinarily Simple Design
Design many hundred times approved, also under unfavorable boiler scale conditions.

OPERATION:

The three Pickers strike about 7200 times a minute and at the same time exert a tearing effect. The Pickers are pivoted and their action is elastically damped in a natural manner by the centrifugal force, they therefore operate free of all shocks, require very little power, do not fatigue, do not wear the edges of the pickers, **do not burr** and will also clean inaccessible parts.

Beware of inferior imitations.

Bader & Halbig, Halle a. Salle (Germany)

Enormous Capacity!

Easy Manipulation.
Small Consumption of Current.
In use with Railways, Shipbuilders, small and large Industrial Plants.

BAWDEN

BAWDEN NEVER SHORT STROKE PUMPS

PUMPS

A Few Sales from May 1st to 9th, 1914

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1—9 x 10 x 10 Packed Piston Water Pump.

Standard Iron & Chemical Co.—Deseronto.
1—20 x 16 x 20 Packed Piston Water Pump.

Wm. Neilson, Ltd.—Toronto.
1—8 x 5 x 10 Pot Valve Outside Packed Boiler Feed Pump.
1—7 x 8 x 10 Brine Pump.
1—10 x 12 x 12 Packed Piston Water Pump.

Canadian Oil Co.—Petrolia.
1—10 x 8 x 10 Oil Pump.

Dept. of Agriculture—Ottawa.
1—5 x 3 x 6 Packed Piston Water Pump.

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2—8 x 10 x 10 Vacuum Pumps.

Imperial Oil Co.—Sarnia.
1—8 x 6 x 10 Oil Pump.

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1—6 x 4 x 10 Pot Valve Outside Packed Boiler Feed Pump.

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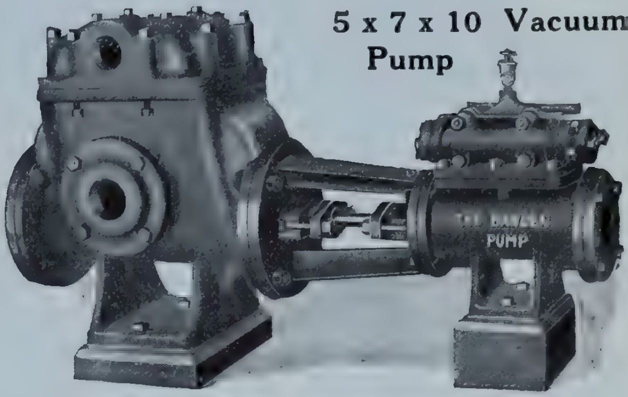
1—5 x 1¾ x 6 Outside Packed Pressure Pump.

5 x 7 x 10 Vacuum Pump



Water Sealed Valves, Brass Liners, Pistons, Rods and Valves

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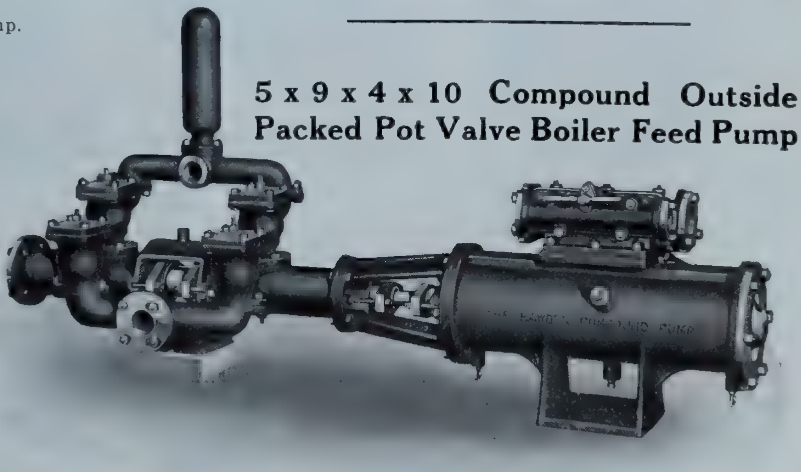
5 x 9 x 4 x 10 Compound Outside Packed Pot Valve Boiler Feed Pump



Bawden Pumps

are very simple. There are no outside rods to stick or get out of adjustment. They're operated by the Bawden Patent Balanced, Steam Moved Piston Valve, which assures a full stroke of the piston under all conditions.

Water Valves have no screwed seats, but are driven in on a special taper and are held solid by brass stoppers through the covers, all parts made on jigs and face machined so no rubber packing is required.

We manufacture Steam and Electric Pumps for all purposes, viz., **Boiler Feed** Pumps; **Circulating** Pumps; **Vacuum** Pumps; **Tar** Pumps; **Brine** Pumps; **Mash** Pumps; **Fire** Pumps; **Accumulator** Pumps.

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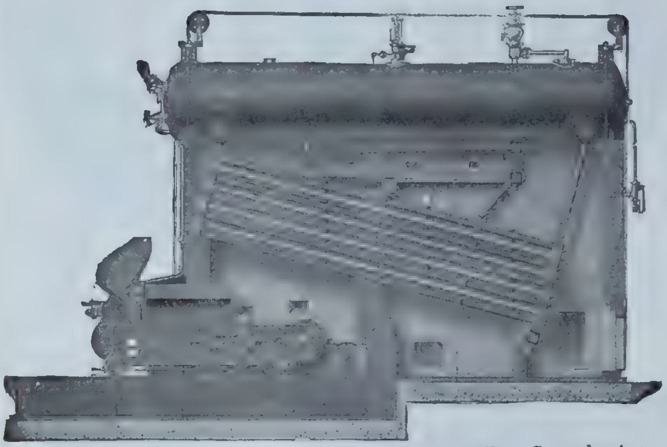
BABCOCK & WILCOX, Limited

"B.&W." PATENT WATER TUBE STEAM BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY. OVER 10,000,000 H.P. IN USE



Babcock & Wilcox Patent Water Tube Steam Boiler, Superheater and Mechanical Stoker.

ALSO

Steam Superheaters
Mechanical Stokers
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Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

Our Book "STEAM" sent on request

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
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Five Questions and the Answer

No. 1. Are you getting the greatest amount of efficiency out of the fuel you are burning?

No. 2. Are the interior surfaces of your Boilers coated with scale?

No. 3. Are the interior surfaces being corroded or pitted?

No. 4. Does your Engineer experience any trouble in the form of foaming or priming?

No. 5. Are your Boilers leaking around the seams and joints?

The Treatment of Boiler Feed Waters

Specified causes must be treated **specifically.** No "cure-all" will act as the proper re-agent to prevent the formation of deleterious substances under any and all conditions.

DEARBORN WATER-TREATING PREPARATIONS are scientifically prepared to meet the requirements of the mineral ingredients and other objectionable constituents of the waters used in **your** boilers. The services of the Dearborn Laboratories are offered free of charge to all power plant operators who experience difficulties due to unsatisfactory boiler-feed supplies.

Our Booklet Explains All

Write for a copy to-day. It gets right down to the root of feed water troubles, and will prove of value to any manufacturer or engineer.

Dearborn Chemical Co. of Canada, Limited

Toronto **Canada**

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Cement Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Drives.
Morse Chain Co., Ithaca, N.Y.

Charging Cars
C. W. Hunt Co., New York.
Orenstein-Arthur Koppel Co., Pittsburg.

Chemicals.
Dearborn Chemical Co., Chicago.
C. C. Snowdon, Calgary.

Circuit-Breakers.
Engineering Works of Canada, Ltd., Montreal.
Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Coal.
Ohio & Michigan Coal Co., Detroit,

Clutches.
Elmira Machinery and Transmission Co., Elmira.
Waterous Engine Wks. Co., Brantford

Coal and Ash Conveyors.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Geo. H. Tod, Toronto.
Theodore Kipp Co., Winnipeg.

Coal Handling Machinery.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. W. Hunt Co., New York.
Geo. H. Tod, Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.

Coils.
Frick Co., Waynesboro, Franklin Co., Pa.

Collars.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.

Cold Storage Insulation.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Robinson Bros. Cork Co., Toronto.
Kent Co., Montreal.

Condensers.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto.
John McDougall Caledonian Iron Wks, Montreal.
Waterous Engine Wks. Co., Brantford
Arctic Ice Machine Co., Canton, Ohio.

Condensers, Ammonia and Steam.
Frick Co., Waynesboro, Franklin Co. Pa.

Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
G. M. Davis Regulator Co., Chicago.

Conduits.
Can. British Eng. Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Can. H. W. Johns-Manville Co., Toronto.
Northern Electric Co., Ltd., Montreal.

Consulting Engineers.
Bayfield & Archibald, Vancouver, B.C
Chas. Bishop, M.I.C.S.A., Montreal.
de Gaspe Beaubien, Montreal.
John T. Farmer, Montreal.
Fetherstonhaugh & Co., Montreal.
Walter J. Francis, Montreal.
Jacobs & Davies, Inc., Montreal.
Pratt & Ross, Toronto.
J. M. Robertson, Montreal.
Surveyor & Frigon, Montreal.
A. V. Tracy-Gould, Montreal.

Contractors, Structural Steel.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.

Conveyor Machinery.
Can. British Eng. Co., Winnipeg.
Ed. Bemis & Co., Little Hulton, Bolton, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Engineering Works of Canada, Ltd., Montreal.
Jeffrey Manufacturing Co., Columbus.
C. W. Hunt Co., New York.
Geo. H. Tod, Toronto.
Waterous Engine Wks. Co., Brantford

Cooler Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Cork Insert Pulleys.
American Pulley Co., Philadelphia.

Cork Insulation.
Can. H. W. Johns-Manville Co., Toronto.
Kent Co., Montreal.
Robinson Bros. Cork Co., Toronto.

Cork Tiling.
Robinson Bros. Cork Co., Toronto.

Cotton Hose.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia,

Counters.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Couplings.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Jeffrey Manufacturing Co., Columbus.

Cranes, All Kinds.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Electric.
Can. British Eng. Co., Winnipeg.
Babcock & Wilcox, Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Cranes, Hand Power.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Overhead Travelling.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Post Jib.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Swing Jib.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Cranes, Wall.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Crank and Crosshead Pin Oilers
Lunkenheimer Co., Cincinnati, O.

Crushing Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.

Cut Outs
Duncan Electrical Co., Montreal.

Damper Regulators.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Geo. H. Tod, Toronto.

Die Stocks.
Borden Canadian Co., Toronto.
Oster Mfg. Co., Cleveland, O.

Distillers.
Canadian Griscom-Russell Co., Ltd., Montreal.

Distilling Apparatus.
Frick Co., Waynesboro, Franklin Co., Pa.
Griscom-Russell Co., New York.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Double Pipe Condensers.
Frick Co., Waynesboro, Franklin Co.,

Dry Cleaners Systems.
S. F. Bowser & Co., Inc., Toronto.

Drying Machinery.
Can. Fairbanks-Morse Co., Montreal.

Dynamos.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Economizers.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.
Theodore Kipp Co., Winnipeg.

Electric Irons.
Northern Electric Co., Ltd., Montreal.

Electrical Accessories and Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
Duncan Electrical Co., Montreal.
Theodore Kipp Co., Winnipeg.
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.

Electrical Repairs.
Siemens Co. of Canada, Ltd. Montreal.

Electrical Supplies
Duncan Electrical Co., Montreal.
Northern Electric Co., Ltd., Montreal.

Elevators.
John McDougall Caledonian Iron Wks. Montreal.

Elevating Machinery.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
C. W. Hunt Co., New York.
Jeffrey Manufacturing Co., Columbus.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

Engines, Automatic and Drop Valve.
Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
John Inglis Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
International Engineering Works, Ltd., Amherst, N. S.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
W. H. Allen Son & Co., Bedford, Eng.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Kerr Engine Co., Walkerville.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brant-

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N. S.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.

Evaporators.
Canadian Griscom-Russell Co., Ltd., Montreal.

Exhaust Fans.
Griscom-Russell Co., New York.
W. H. Allen Son & Co. Bedford, Eng.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.
Griscom-Russell Co., New York.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
International Engineering Works, Ltd., Amherst, N. S.
Nobis Engineering Co., Toronto.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Griscom-Russell Co., New York.

Filters.
Canadian Griscom-Russell Co., Ltd., Montreal.
John McDougall Caledonian Iron Wks. Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.,
Theodore Kipp Co., Winnipeg.

Fire Extinguishers and Fire Alarm Apparatus.
Northern Electric Co., Ltd., Montreal.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick and Clay.
Betson Plastic Fire Brick Co., Rome, N.Y.

Fire Box Blocks.
Betson Plastic Fire Brick Co., Rome, N.Y.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
William B. Pierce Co., Buffalo, N.Y.

Flue Gas Analysis Instruments.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnaces
John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert.

Furnace Linings and Arches.
Betson Plastic Fire Brick Co., Rome, N.Y.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto
Northern Electric Co., Ltd., Montreal.

Fuses, Renewable.
Economy Fuse & Mfg. Co. of Canada, Montreal.

Gas Analysis Instruments, Etc.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gaskets, Rubber, Asbestos, Lead and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Durabla Mfg. Co., New York.
Frick Co., Waynesboro, Franklin Co.,
Goetze-Gasket & Packing Co., New Brunswick.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.

Gas Producer Plants.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene & Oil Storage & Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
Durabla Mfg. Co., New York.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges, Ammonia, Oil, Gas, Air.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gears, Cut, Worm, Mortise.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Generators and Convertors.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Griscom-Russell Co., New York.
Siemens Co. of Canada, Ltd. Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.

Gongs.
Northern Electric Co., Ltd., Montreal.

Governors, Water Wheel
W. H. Allen Son & Co., Bedford, Eng.

Graphite, Boiler.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Governor, Water Wheel.
Can. Allis-Chalmers, Ltd., Toronto.

Graphitol.
C. C. Snowdon, Calgary.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.

Grease Cups.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.

Greases.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Griscom-Russell Co., Ltd. Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Heating Engineers.
Nobis Engineering Co. Toronto.
Theodore Kipp Co., Winnipeg.

Hoists.
Engineering Works of Canada, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Nobis Engineering Co., Toronto.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
C. W. Hunt Co., New York.
John Inglis Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

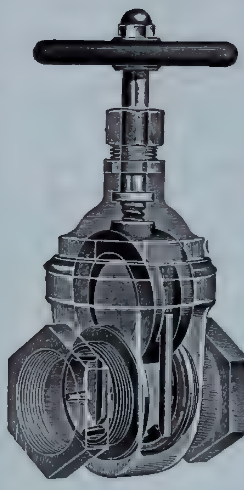
Hydraulic Machinery.
W. H. Allen Son & Co., Bedford, Eng.
John Inglis Co., Ltd., Toronto.
John McDougall Caledonian Iron Wks. Montreal.
Nobis Engineering Co., Toronto.

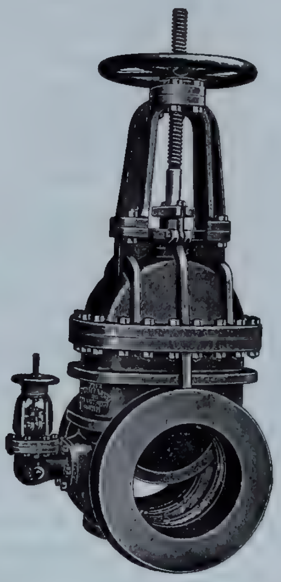
Hydraulic Presses.
Bawden Machine Co., Toronto.

Ice Making Machinery.
Arctic Ice Machine Co. Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co.,
Linde British Refrigeration Co., Montreal.
John Inglis Co., Ltd., Toronto.
York Mfg. Co., York, Pa.

Insulators.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Geo. H. Tod, Toronto.
Northern Electric Co., Ltd., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.





Pratt & Cady Valves

with Renewable Bronze Seat Rings

Those who are looking for a valve of the highest grade, one which they can rely upon to help in their "Safety First" campaign, will do well to choose the P. & C. line of gate valves, made in Brass and Iron from 1¼″ up; they all have the same

Retaining Ring Construction

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. These seats can be renewed by removing the retaining rings with a suitable wrench made for the purpose, or other appropriate tool. The gate is a double-faced, wedge-shaped casting, with side grooves by means of which it slides on guides in the valve body.

Great pains are taken in the machining of all parts of these gate valves. Gauges are used on each part to insure their accuracy and interchangeability. The guides in the bodies are of equal thickness, and the wedges can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double-seated can be used with the pressure applied at either end.

For Superheat and High Pressure, Wet Steam and Oil, use Durabla Packing.

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Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric Co., Ltd., Montreal.

Lubricants.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary.
Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.

Magnetos.
Northern Electric Co., Ltd., Montreal.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Measuring Instruments.
Northern Electric Co., Ltd., Montreal.

Metal Spools.
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Can. British Eng. Co., Winnipeg.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.
Siemens Co. of Canada, Ltd. Montreal.

Metres, Steam.
Nobis Engineering Co., Toronto.

Meters, Water.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Mica.
Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Jenckes Machine Co. Sherbrooke, Que
International Engineering Works, Ltd., Amherst, N. S.
Goldie & McCulloch Co., Galt.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
Bawden Machine Co., Toronto.

Motors.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Motor Starters and Controllers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd. Montreal.

Office Railings.
Jas. Morrison Brass Mfg. Co., Torento.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
S. F. Bowser & Co., Inc., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Heaters and Coolers.
Griscom-Russell Co., New York.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
S. F. Bowser & Co., Inc., Toronto.
Theodore Kipp Co., Winnipeg.
Lunkenheimer Co., Cincinnati, Ohio.

Oils, Lubricating.
Can. Oil Companies, Ltd., Toronto.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.

Packing Engine.
Canadian Gasket Co., Bridgeburg, Ont.
Can. H. W. Johns-Manville Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.

Packing, Hydraulic.
Greene, Tweede & Co., New York.

Packing, Metallic.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Mansville Co., Toronto.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Greene Tweed & Co., New York.
Nobis Engineering Co., Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
Graton & Knight Mfg. Co., Worcester, Mass.

Patents.
Rowland Brittain, Vancouver, B.C.

Penstocks.
Can. Allis-Chalmers, Ltd., Toronto.
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Pacific Coast Pipe Co., Vancouver, B. C.

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Imperial Waste & Metal Co., Montreal.

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Can. Allis-Chalmers, Ltd., Toronto.
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Waterous Engine Works Co., Brantford.

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Herbert Morris Crane & Hoist Co., Ltd., Toronto.

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G. W. Hoffman, Indianapolis.

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W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
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Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
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Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.

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American Pulley Co., Philadelphia.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
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Siemens Co. of Canada, Ltd. Montreal.

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W. H. Allen Son & Co., Bedford, Eng.
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Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

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American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
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Bawden Machine Co., Ltd., Toronto.
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G. M. Davis Regulator Co., Chicago, Ill.
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Canadian Steam Boiler Equipment Co., Toronto.
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Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
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Bromell Patents Co., Ltd., Glasgow, Scotland.
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Escher, Wyss & Co., Toronto.
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Smart - Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
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The Bawden Machine Co., Toronto.
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Can. Fairbanks-Morse Co., Montreal.
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Manzel Cros. Co., Buffalo, N.Y.
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S. F. Bowser & Co., Inc., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
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Smart - Turner Machine Co., Ltd., Hamilton.

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William Hamilton Co., Ltd., Peterborough.

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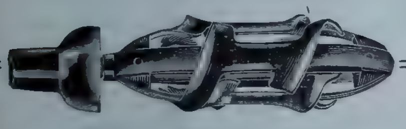

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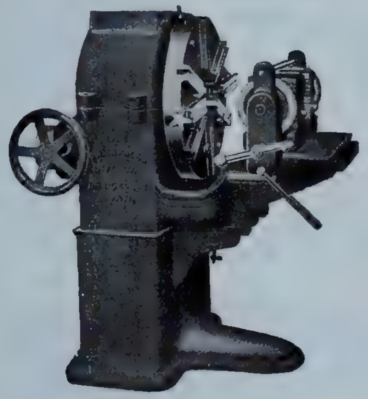

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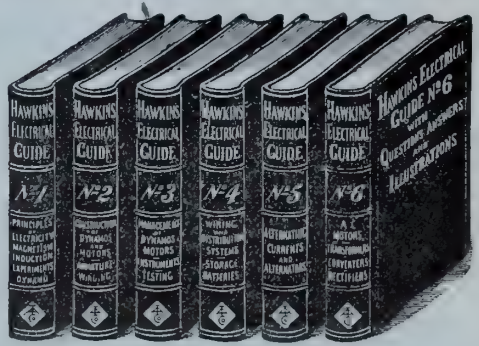
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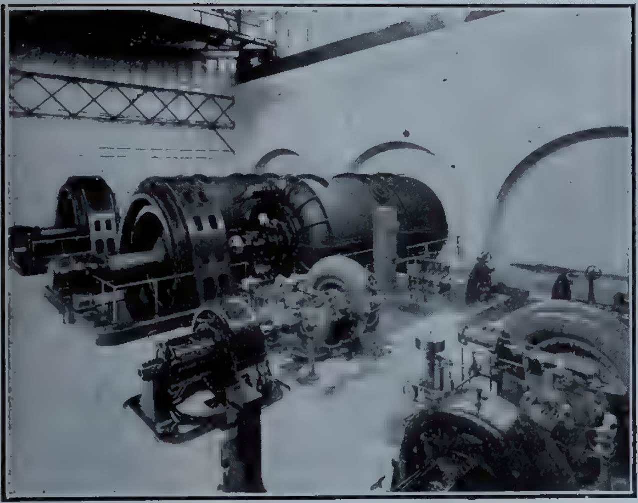

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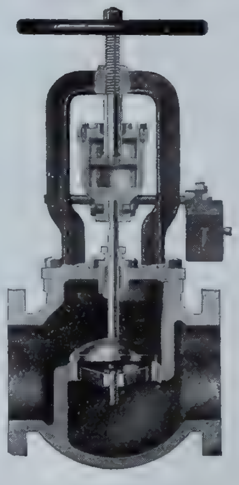

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for Stationary Boilers

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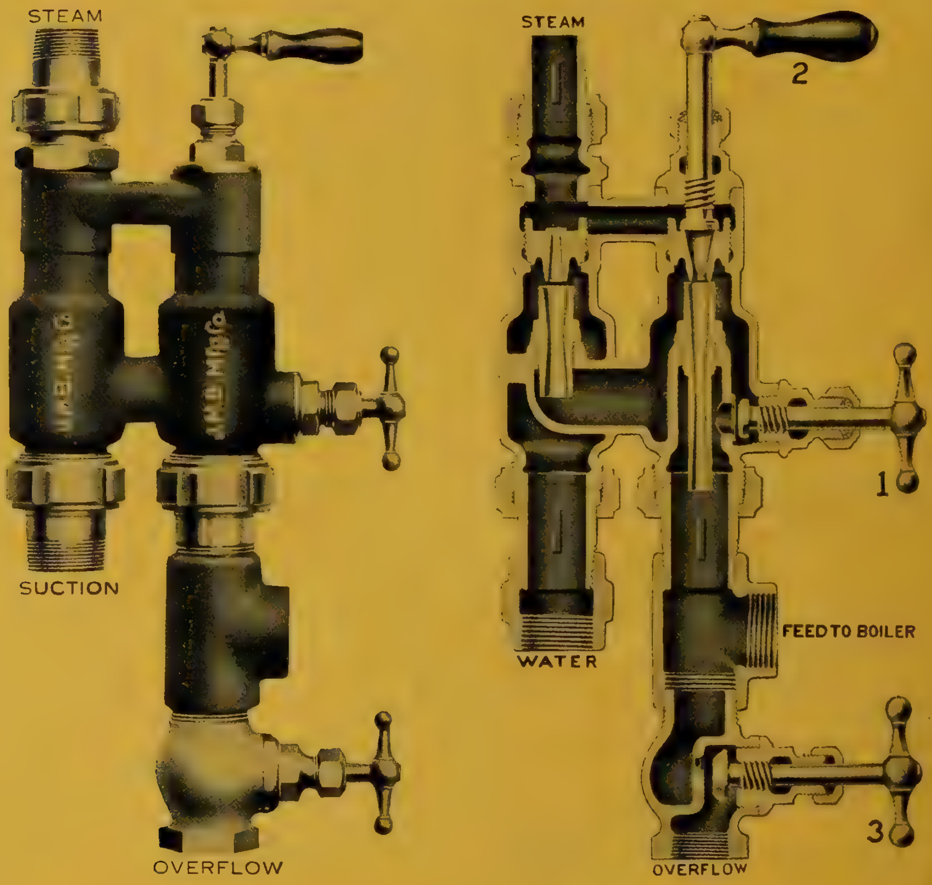

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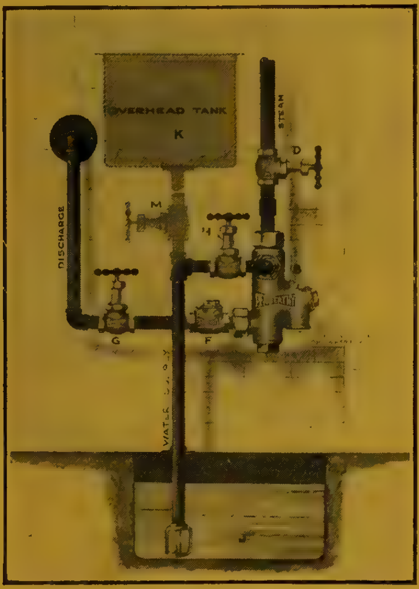

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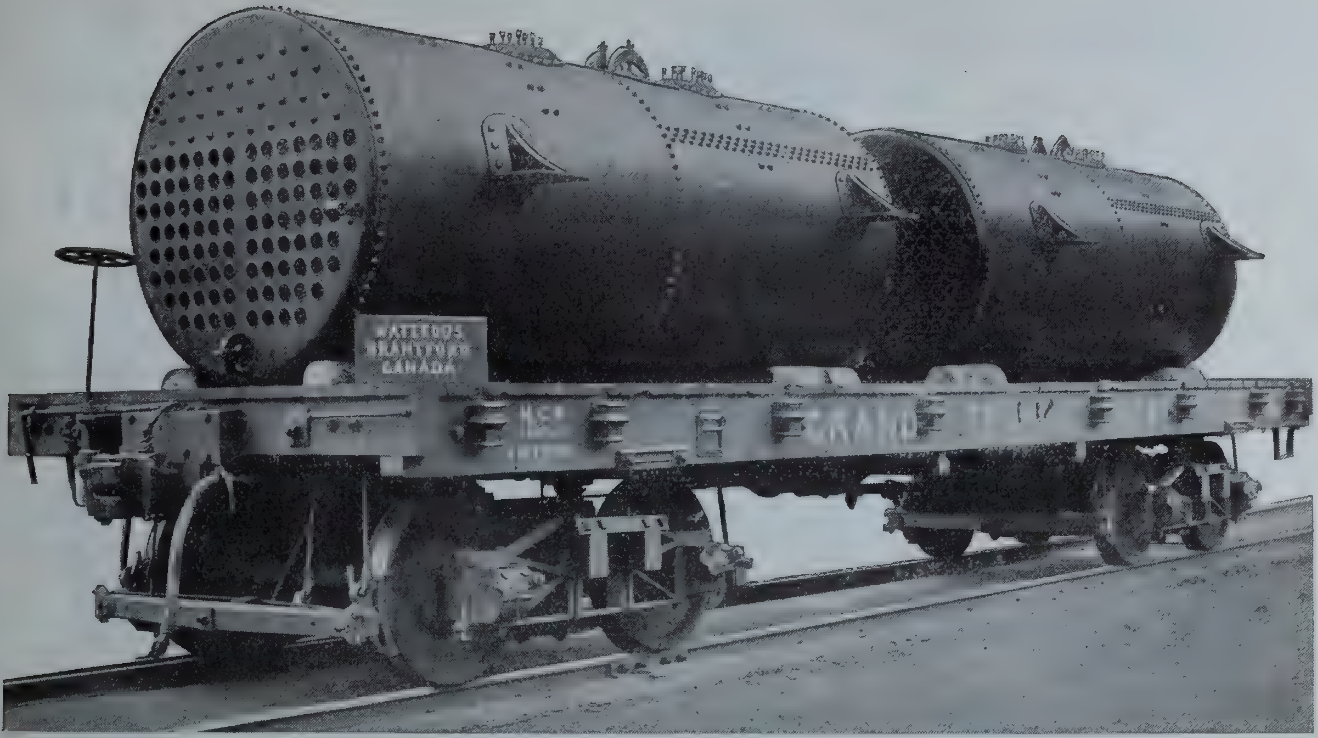

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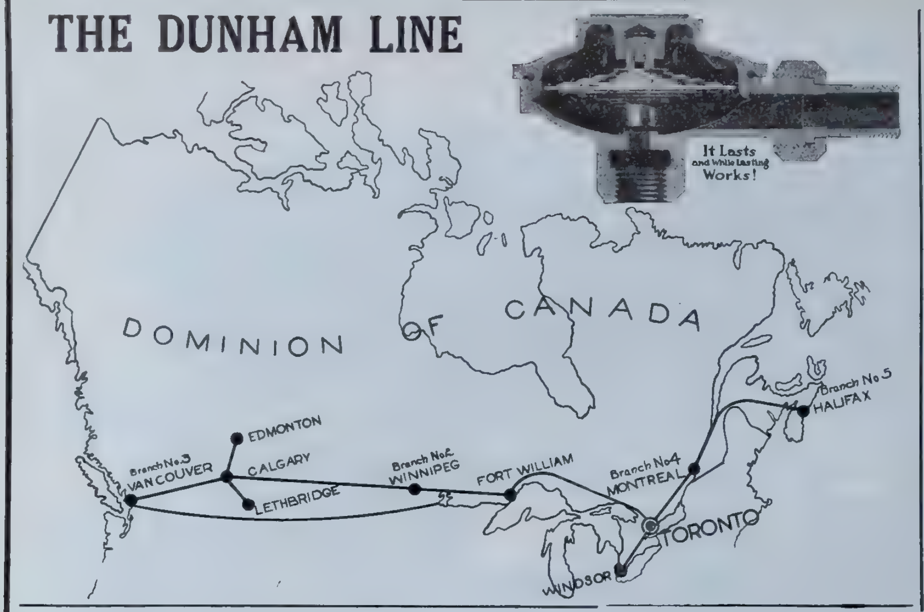

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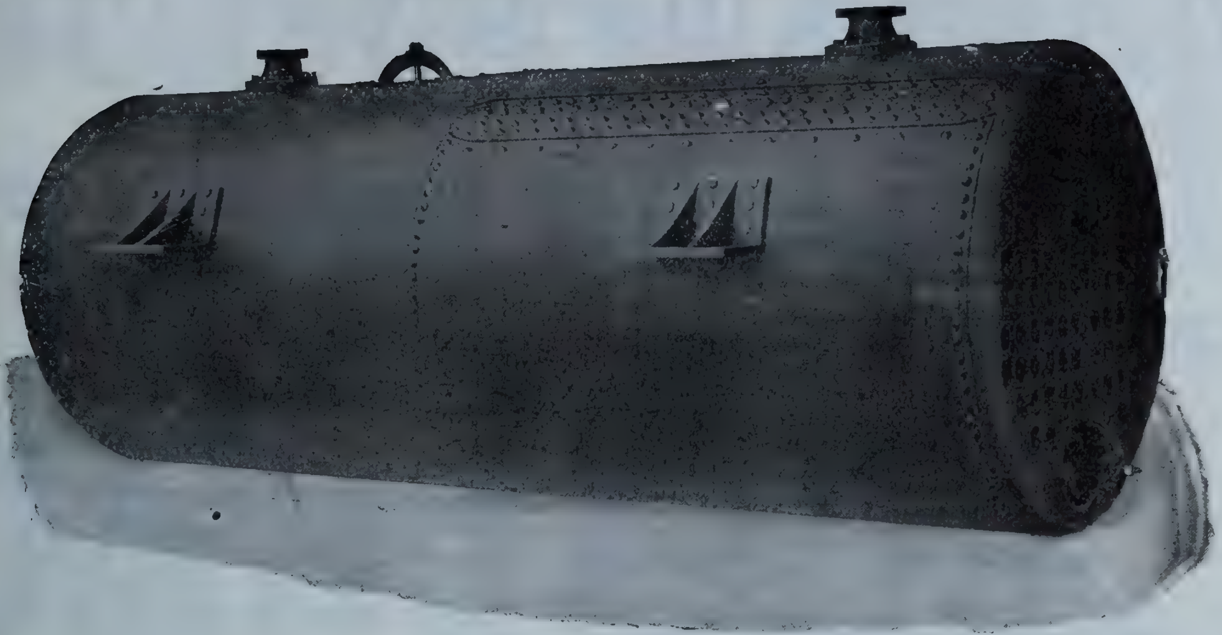

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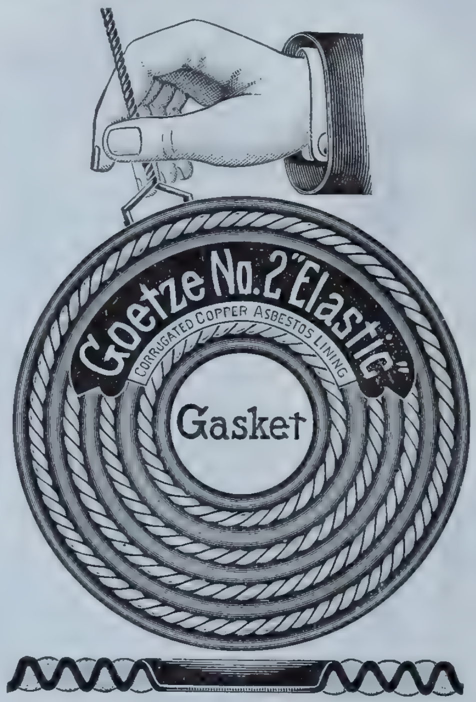

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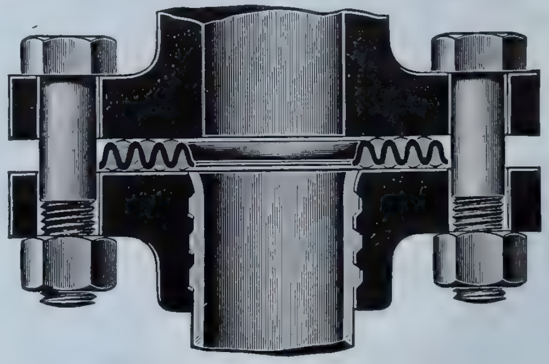

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Air Brake Gaskets.
Special Moulded Goods for every Mechanical Use.
Tubing—all sizes.
Rubber Strips.

RUBBER BOOTS AND SHOES. "Jacques Cartier," "Merchants," "Dominion," "Anchor," Brands.

Fleet Foot Outing and Sporting Shoes.

Felt Boots and Specialties, "Berlin" Brand

Automobile Tires Truck Tires Carriage Tires

Original "Diamond" design Inlaid Rubber Tiling. Estimates and Samples cheerfully furnished. We specialize in Rubber Goods required by Steamboat and Electrical Car Companies.

Write for Catalogues and Prices.

BRANCHES :

Halifax St. John Quebec Montreal Granby Ottawa Toronto Hamilton Brantford London Berlin Port Dalhousie North Bay Winnipeg Calgary Edmonton Saskatoon Regina Vancouver Victoria

Pulleys Pull Profits Up or Down

A poor pulley **wastes power.**
A good pulley **conserves power,** reduces wear and tear, cuts down coal consumption, saves your money.

"American" Steel Split Pulleys

combine great lightness with supreme strength, superior belt grip, balance, practical indestructibility, and convenience of installation.
That is why more "Americans" are in use than any other one make of metal pulleys.

PATENTED

Made in sizes 3" to 60" diameters, inclusive.
Pulleys above 60" diameter on application.
Instructive printed matter on request.

The American Pulley Company
Office and Works : Philadelphia, Pa.

Stocked and sold by dealers.

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS:—Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N. B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.

Cling-Surface effects savings in more ways than you can imagine.

Savings from the use of Cling-Surface pop up from many sources: Where belt slip is stopped without tightening belts and its attendant useless increase of bearing pressures, coal is saved in quantities, year in and year out, that pays for the Cling-Surface and its application dozens of times over. Cling-Surface treatment more than doubles or trebles the life of belts that otherwise are run tight, for the pliability and softness which it imparts to both interior and exterior permit the belt to run slack with less slip than is present in a tight belt.

The truth of these statements is forcibly emphasized in the following remarks of Mr. Jerry Lynch, 196 East 205th St., New York, a self-styled "Cling-Surface Bug" who was put in charge of M. P. Davis' plant, Niagara Falls, Ont., where belts were once run extremely tight:

"They burned out many sets of main bearings on those compressors. After Cling-Surface came, I asked them to allow the belts to go on without taking up, which they did. We cut the oil bill from five gallons a day to five gallons a week, and once ran for over three months without stopping, and no trouble."

Mr. Lynch was there 25 months. During that time they needed *only one gallon* of Cling-Surface.

This is perhaps an exceptional case, and an extremely high oil-saving record. But it is important in helping to prove Cling-Surface treatment the logical solution for belt troubles.

Belts partially ruined because of wrong treatment or no treatment can still be reclaimed with Cling-Surface, which, applied correctly, nourishes all the good still in them and checks the deterioration. Ask anyone who is using Cling-Surface. Give Cling-Surface a trial or at least write for more information to-day.

We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo N Y

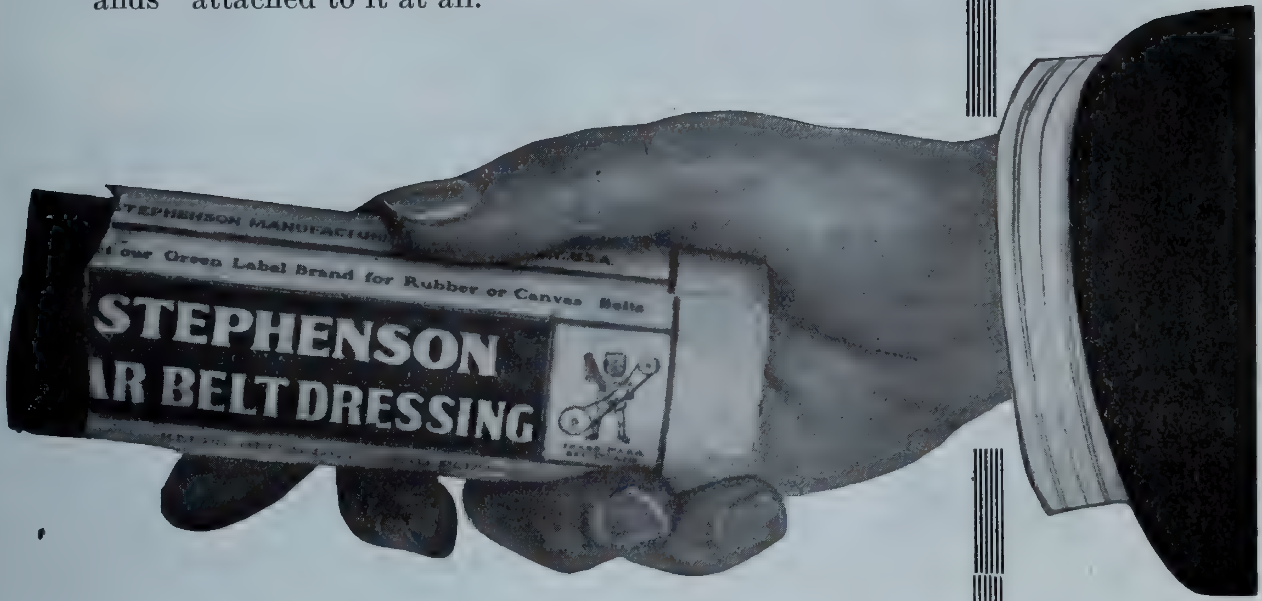
I am interested in Cling-Surface and your trial order proposition.

Name .... Position ....
Firm ....
Street ....
City .... State ....

61

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.

Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.

Gentlemen: Kindly send me free of charge a half-pound sample of your belt dressing.

Name ....

Firm ....

Address ....

G&K 1851
TRADE MARK

Educational Talks on Leather Belting.

Proper Selection of Belting

The remarkable improvement in the manufacture of leather belting, made necessary by the development of modern efficient machinery, is of little avail if the proper selection and application of belting are neglected.

The use of unsuitable belting invariably results in increased expense due to one or more of the following objectionable features: excessive or uneven stretching, slippage, undue friction in bearings, loss of power, frequent interruptions to machinery and consequent loss in production, to say nothing of the early destruction of the belting.

On the other hand, the adoption of belting constructed to meet each condition of service insures low cost of operation and maintenance, as well as the maximum production from machinery.

There is one best belt for every drive.

For Vertical Drives—Belts of as light weight as is consistent with sufficient tensile strength to transmit the required power.

For Quarter Turn Drives—Belts of special construction, those for quarter turn to left made different from belts to operate on quarter turn to right.

For High-Speed Work—Heavy single belts with special laps, or light double belts.

For Intermittent Loads—Heavy belts with high coefficient of friction.

For Exposure to Steam, Gas or Oils—G. & K. Spartan Belts made from leather specially tanned and curried and put together with a special cement.

For Exposure to Water or Moisture—G. & K. Neptune and Spartan Waterproof Belts put together with Waterproof Cement — the use of either brand depends entirely upon the construction of the drive.

From the foregoing, the absurdity of adopting one quality and weight of belting for all drives is apparent.

To meet different conditions of service we manufacture several brands of belting, each rigidly graded as to quality, weight and thickness.

Our Engineering experts will gladly assist you in analyzing any type of drive or in the selection of belts calculated to render the greatest service. Consult us freely.

THE GRATON & KNIGHT MANUFACTURING CO.

Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory: Worcester, Mass., U.S.A.

"Consult our Engineering Department in connection with your Transmission Problems"

This Mark On Belting

is a warranty of long service and very small upkeep cost.

This trade-mark guarantee is on every piece of

D. K. McLaren's

Genuine British Oak-Tanned

Leather Belting

It will be to your interest to buy this belting, because it will keep you FREE from belting troubles that are inseparable from inferior belts, such as breakdowns, loss of power, slippage, stretch, etc.

The secret of the success of this belting lies in the fact that it is under the supervision of experts, from the selection of hides till the final finishing touch (the trade-mark) is applied — and that our genuine British Oak method of Tanning makes leather exceptionally tough, durable, and pliable.

Let us send our Catalogue and put you in touch with users.

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Toronto 200 King St. W.
Vancouver 847 Beatty St.
St. John, N.B. 64 Prince William St.

MAIL THIS COUPON.

D. K. McLAREN, Limited,

Gentlemen,—Please put me in touch with some users of your belting.

Name . . . .

Address . . . .

Firm . . . .

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ENDORSED BY

GULLETT GIN CO.
1888-1914
The Leading Builders of Cotton Gins.
A very severe service because of

GRIT, DUST AND HIGH SPEED

GULLETT GIN COMPANY
Manufacturers
COMPLETE COTTON GINNING OUTFITS.

P.O. Amite, La., Feb. 4th, 1888.

Gentlemen:—We are using your MAGNOLIA METAL in our Magnolia Gins, Feeders and Condensers to our entire satisfaction.

We have adopted Magnolia Metal as the standard anti-friction compound for our machinery, believing it superior to any we have heretofore used.

Yours truly,
GULLETT GIN CO.
Geo. A. Peete, Mgr.

GULLETT GIN COMPANY
Manufacturers
COMPLETE COTTON GINNING OUTFITS.

Gentlemen: P.O. Amite, La., Feb. 26th, 1914.

It gives me pleasure to state that Magnolia Metal is used by us in all high-speed bearings throughout our line of cotton ginning machinery and has given our customers as well as ourselves excellent results. We wish to state further that we have not had a single complaint where Magnolia Metal has been used.

We are also pleased to say that we use nothing but MAGNOLIA METAL to repair bearings of our high-speed wood-working machinery in our wood-working plant, which consists of about forty-five wood-working machines ranging in size from a 12x30" S.A. Woods Timber Sizer down to a 12" hand jointer, embracing quite a number of different types and makes, bearings in some of which have been running almost continuously 3500 R.P.M., ten hours per day, for five years, and show little or no perceptible wear.

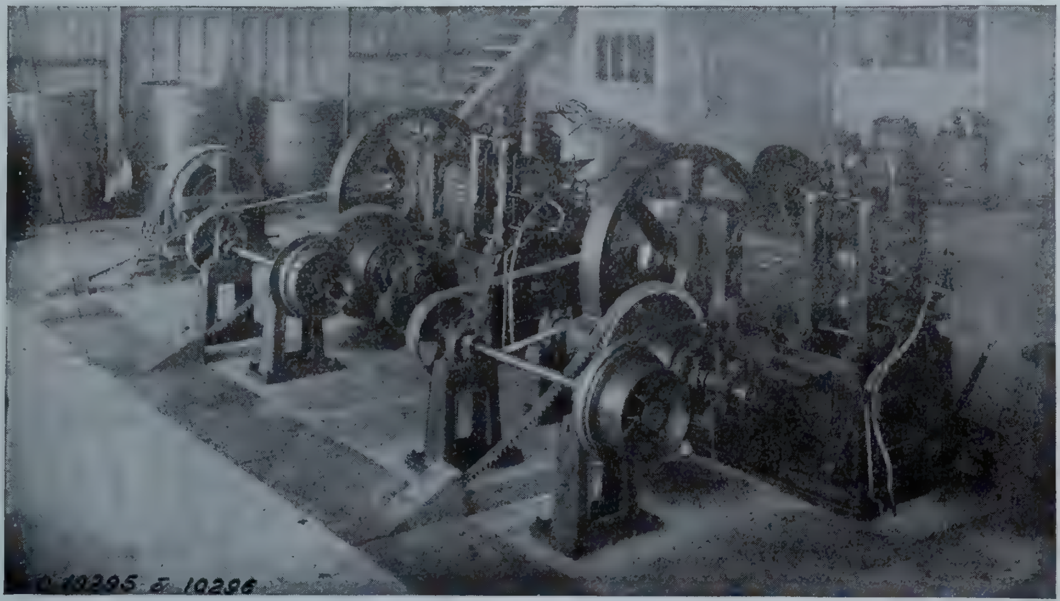
Very truly yours,
GULLETT GIN CO.
T. E. Johnson, Supt.

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL



30 and 15 horse-power Morse Silent Chains driving Cold Rolls installed at Ithaca, N.Y. These chains run at 1,350 and 1,170 ft. per minute; have been in daily use since 1908.

In our own plant, we practice what we preach

WE use "Rocker-Joint" Silent Chains on nearly all the machines in our plant so that every bit of power from our power plant becomes available for productive use in the machines—practically none being lost in transmission.

Whether you buy your power or make it, remember, power costs money.

Let us tell you how we save money on power, how others in your line of business save money or increase their production.

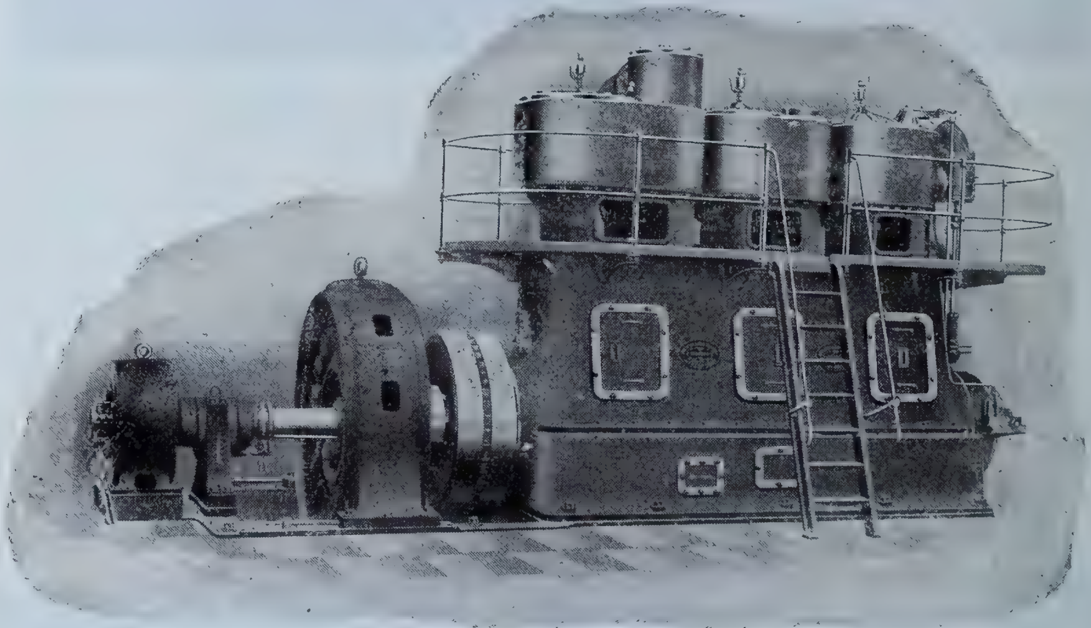
Morse Chain Company, Ithaca, N.Y. B-24

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.

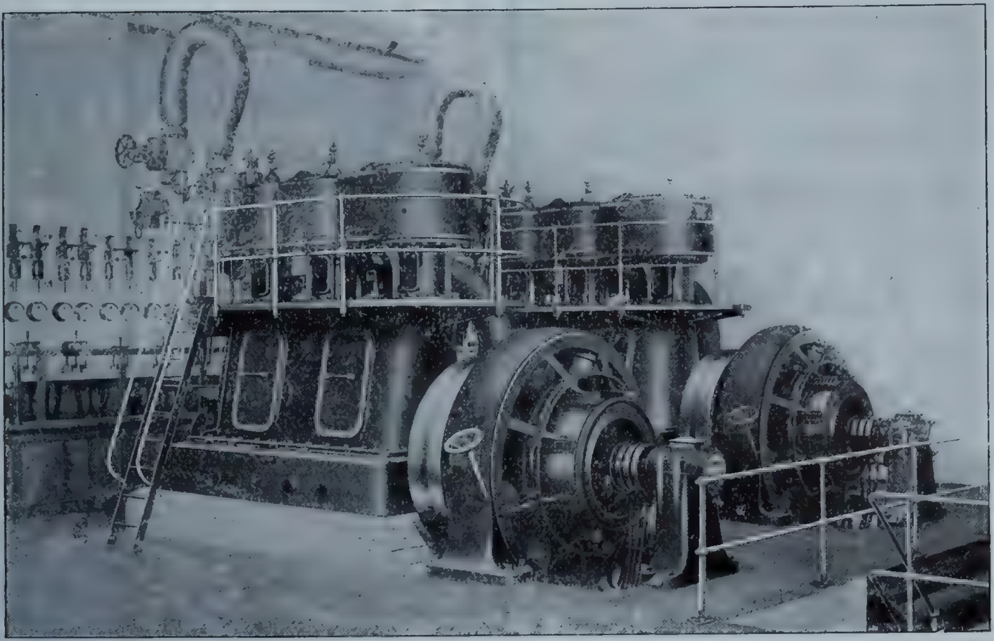
THE BELLISS ENGINE

THE HIGH-SPEED, DOUBLE-ACTING, FORCED-LUBRICATION ENGINE WAS ORIGINATED BY US IN 1890, AND SINCE THAT DATE WE HAVE ACTUALLY MANUFACTURED

5,000 ENGINES

REPRESENTING

1,000,000 HORSE POWER



600 H. P., 350 R. P. M., Belliss Triple Expansion Engine.

Two of the Above Type of Engines Recently Ordered for the Toronto Waterworks.

We have installed upwards of 150 Belliss Engines in Canada.

Manufacturers:

Belliss & Morcom, Limited

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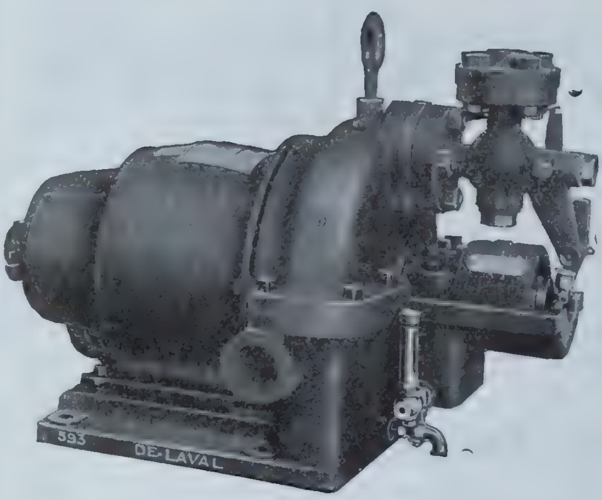


De Laval Class "C" Turbine, directly connected to 1 KW Direct-current Generator.

Efficient and Practical Small Turbine-Exciter and Lighting Sets are Made Possible by the

DE LAVAL Class "C" Turbine

The turbine, which is mounted on the same bed plate with the generator, contains only few and simple parts and requires no further attention than the occasional filling of the oil wells.

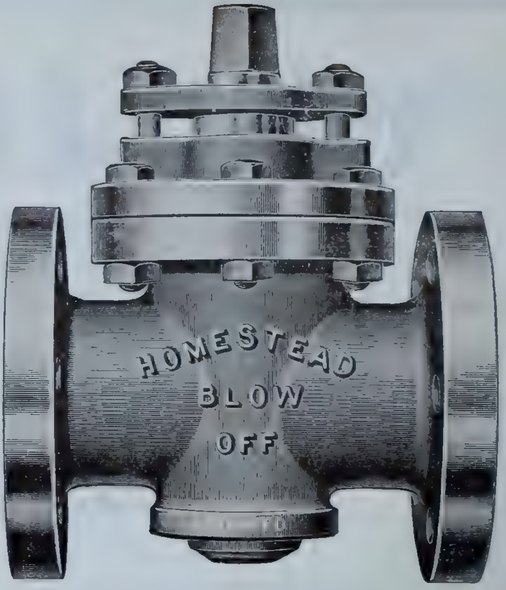
The speed is controlled by a powerful and simple governor, of the same design as that long used on DeLaval Single-Stage Turbines. In addition there is an emergency governor which trips an auxiliary valve in the steam supply line in the event of overspeeding. Damage to surroundings or wheel case is prevented, in case of accidental failure of both governing devices, by a steel armor ring entirely surrounding the wheels.

These small turbines, utilizing the velocity-multi-staging principle, are simple, rugged and reliable and give high economy.

For further particulars regarding De Laval Type "C" Turbines for driving centrifugal pumps and blowers and direct and alternating current generators, send for our Catalogue C61.

DE LAVAL Steam Turbine Co.

Trenton 70 **New Jersey**



Homestead Valves are Quality Valves

A quarter turn—just a slight twist of the wrist—closes or locks the *Homestead.* A quarter turn back opens it wide. It being free from friction, long life and the maximum of service is assured. This valve cannot jar open—when you lock it, it stays locked. The seats are perfectly protected from wear both when closed and when pressure is passing through them. *Every valve* is hand ground to a perfect fit and tested before shipment. They are absolutely leak-proof under any steam, air or hydraulic pressure. *Homestead Valves* are giving satisfaction throughout the entire world, under the most severe conditions. Just try one if the valves you are now using are weak in some essential point. The many superior points of *Homestead* Straightway, Three-way and Four-way Valves fully described in our catalog. Have a copy ?

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P.O. Box 1754
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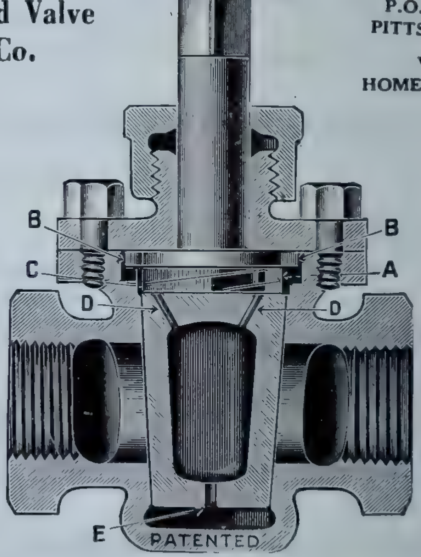
Works:
HOMESTEAD, PA.



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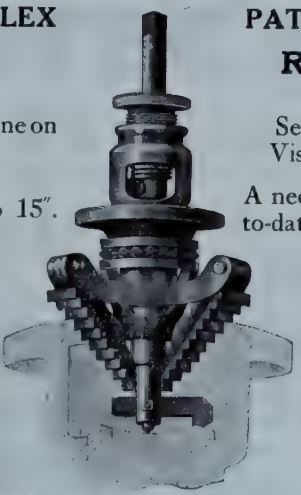
SIMPLEX VALVE

PATENT RESEATER



Simplest Machine on Market.

All Sizes up to 15″.

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Self-Centering Visible Cutters

A necessity in an up-to-date Power Plant.

Faces Valves with Flat or Angled Seats

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WHEELER
Condensers

Are celebrated throughout the world. The Wheeler Condenser & Engineering Co. was one of the first companies to concentrate its entire energy on the design of steam condensing machinery.

An office has recently been opened in

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122 Board of Trade Building
Mr. Jos. MacKay, Jr., Manager.

Wheeler Condensers are built in Barometric, Jet and Surface Types for moderate vacuum and for the highest attainable vacuums for steam turbine work. Vacuums of 28, 29 inches and more are assured.

Wheeler Condenser & Engineering Co.,
Works: Carteret, N.J., U.S.A.
Montreal: 122 Board of Trade Building.

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At our Winnipeg Warehouse

A Car of E.C.C. Motors

MANUFACTURED BY

The Electric Construction Co.
WOLVERHAMPTON

These Motors are three-phase, sixty-cycle, 220 and 550 volts.
Sizes over 5 H.P. complete with Auto Starter.

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THE CANADIAN BRITISH ENGINEERING CO., Ltd.

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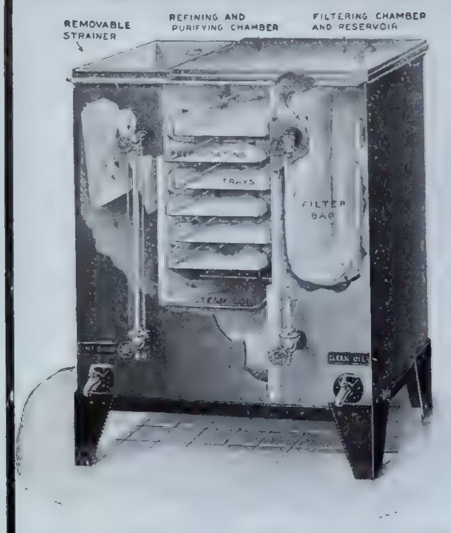
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REFINING AND PURIFYING CHAMBER
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Bowser 7F Type Oil Clarifying Outfit, Intended for use in small plants which have comparatively small amounts of oil drips to handle. Other Individual and Central Oil Clarifying Systems at rated capacity of from 5 to 6000 U. S. gallons or more per day.

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In a Bowser System the quality of the oil is always kept uniformly high. It is all utilized. There can be no leaks—no waste—no loss any way. The great saving and added efficiency quickly repay the cost.

BOWSER ESTABLISHED 1885 **Oil Filtering and Circulating Systems**

For twenty-nine years Bowser has been making oil storage systems to meet every known requirement. Today there are five hundred different Bowser Systems—a million users.

Bowser Systems range from simple Individual hand filtering units to complete yet equally simple Central oil clarifying systems.

What They Do

Reduce friction to the absolute minimum. Provide stream feed in the highest sense of the term. Reduce fire hazard. Save time and labor of men. Save storage space. Compel accuracy and care on part of employees. Make every drop of oil usable **over and over again.**

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Let Bowser confer with you about **your** oil storage needs. Twenty-nine years of such experience may mean something to you. Ask questions. Tell something of your requirements. No cost in finding out. No obligation.

Write today—NOW.

Engineers and Manufacturers of Oil Handling Devices

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Sales Offices in all Centers and Representatives Everywhere

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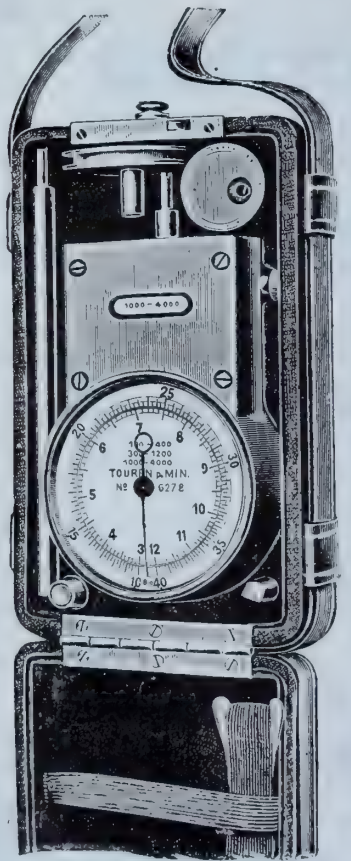
(DR. HORN'S LATEST IMPROVED TYPE)



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Hand and Stationary Instruments Suitable for all Purposes.

TESTING TACHOGRAPHS

Exceedingly Sensitive, Will Record the Slightest Change in Speed of Machine.

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A Revolution Counter and Centre Second Stop Watch Combined to Operate Simultaneously.

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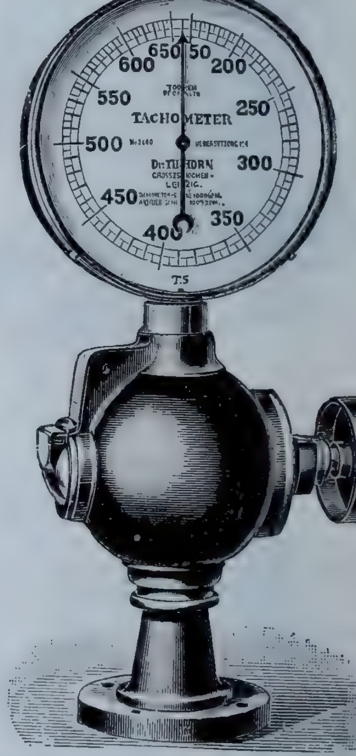

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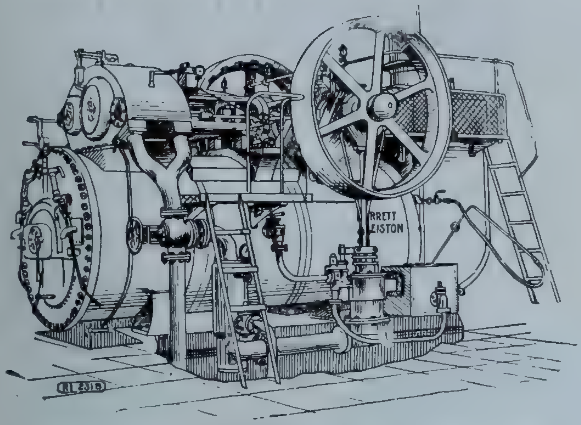
With Gas Producer Economy **Steam Engine Reliability**



THE GARRETT (SUPERHEATED STEAM SEMI-STATIONARY) ENGINE.

Require only 1¼ Lbs. OF COAL PER B. H. P. HOUR.

Sizes 40 H.P. to 250 H.P.

Can use any kind of fuel Anthracite, Bituminous, Lignite, Wood, Shavings, Sawdust, Oil or Gas.

Just the Power for the Small Town.
Electric Light or Pumping Plants.
Mills or Factories.

Efficient, Reliable, Economical.

Correspondence Solicited.

Theodore Kipp Company

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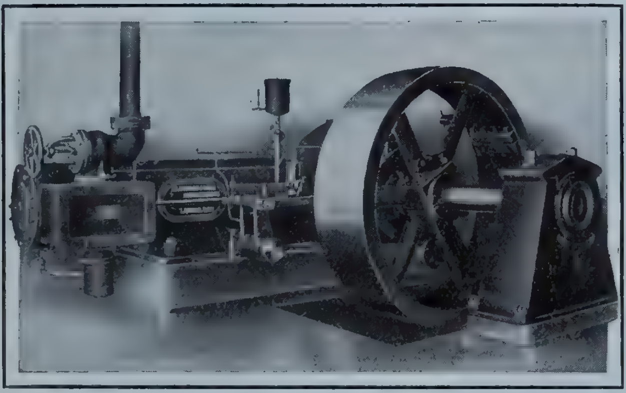

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Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

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MANUFACTURERS OF
High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants
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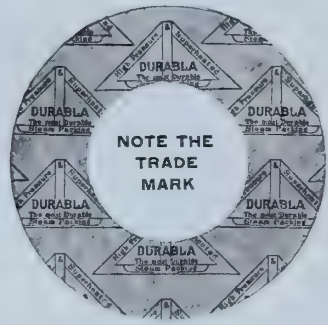

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Increases efficiency, and lowers the cost by the year.

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The cost of handling material around your plant—Does it make a perceptible dent in your profits? Then write

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Tell them your problem—and ask for *any* or *all* of the following catalogues:

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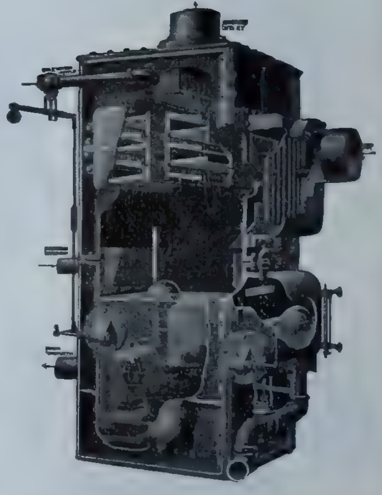
They describe fully our complete line of machinery for the economical handling of bulk material, and undoubtedly contain information which will be of value to *you.*

COCHRANE STEAM SPECIALTIES

The "Multiport" Valve.

If you have a problem relating to the heating, purifying or metering of water for boiler feed or other purposes, or to the removal of water and oil from live and exhaust steam, or to the proper regulation of back-pressure or vacuum or heating systems or condenser lines, refer it to us with full particulars and we shall be pleased to give you our suggestions.

See our Bulletin: *"Feed Water Meters and their application."*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ENGINEERS AND BUILDERS OF

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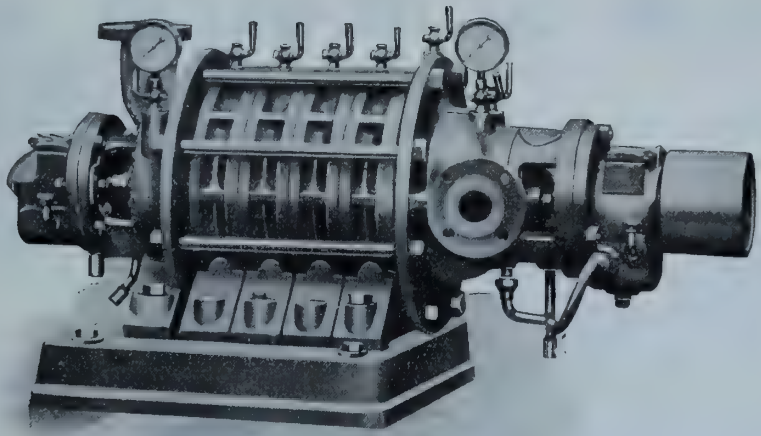

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PUMPING MACHINERY

Above illustration shows a five-stage pump, sixty Imperial gallons per minute, 450 ft. head, 2,500 r. p. m.

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BRITISH COLUMBIA

For prices and full particulars, apply to head office at

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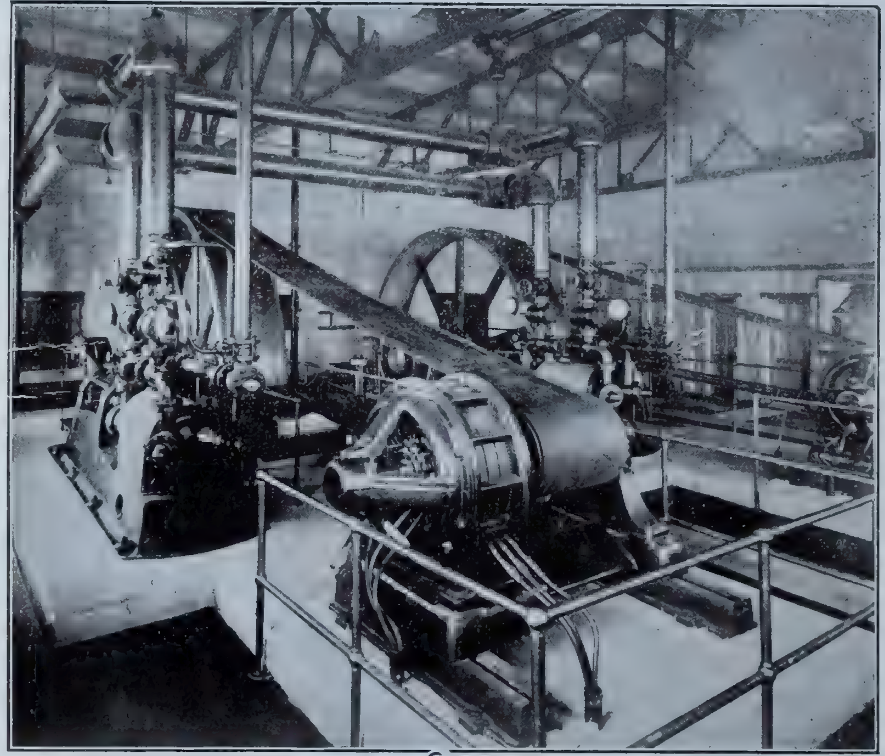
REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogues and estimates upon request.

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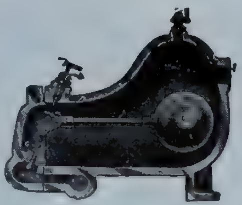
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.

EXCELSIOR ANHYDROUS AMMONIA

PURE
GUARANTEED
DRY

EFFICIENCY
100%

CANADIAN
AMMONIA CO.,
LIMITED
TORONTO, ONTARIO

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

Bulletins sent on request.

The Vilter Mfg. Co.
242 Becher St. Milwaukee, Wis.

DE LA VERGNE REFRIGERATING MACHINERY

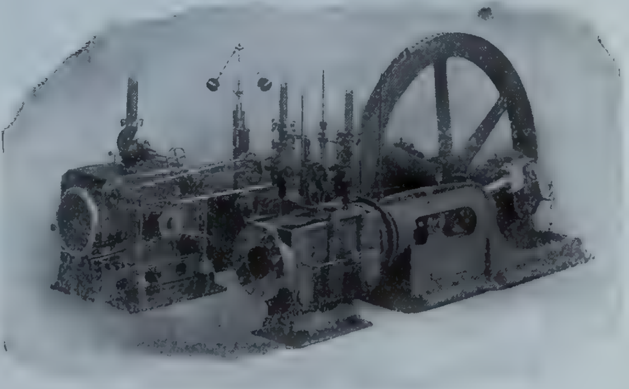
is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name **De La Vergne** stands for **highest quality, maximum capacity, absolute reliability** and **permanent economy.**

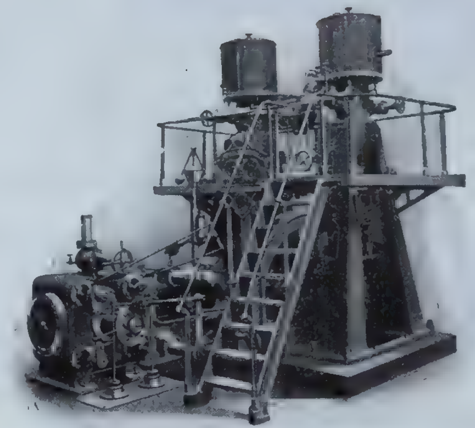


Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada



Durability is Reliability

Durability saves costs in repairing.
Reliability saves costs in accidents.
Both save costs due to shutdowns.

To have the peace of mind and confidence that the owner of a **FRICK** Machine enjoys during the rush season in midsummer you must be the owner of a **FRICK Machine.**

It costs a little more, but it's cheapest in the end.

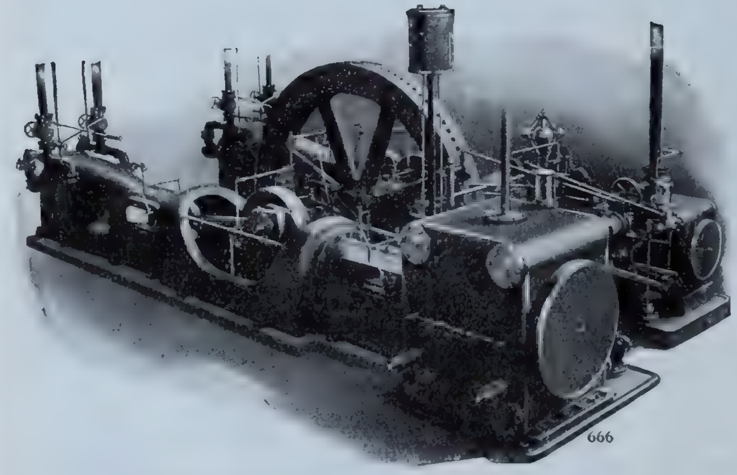
It is built with but one aim in view—to make it as durable and reliable as a refrigerating machine can be made. If a weakness develops in the smallest part it is immediately removed—no part is left to chance. Every part is made very heavy and the best materials known are used in its construction.

The result—a machine having the highest degree of durability and reliability—the best for its purpose—the cheapest and safest.

Canadian Representatives:
Keith's Limited
297 Campbell Ave. Toronto

FRICK COMPANY
Waynesboro, Pa., U. S. A.

York Horizontal Double-Acting Refrigerating Machines



York Horizontal Duplex Machine (Latest Design).

are well made—from the selection of raw materials to the final test of the finished Machine. There is a pride and pleasure in knowing that your work is well done.

Our Horizontal Double-Acting Refrigerating Machine is a good example of what can be accomplished with carefully selected materials in the hands of expert designers and skilled mechanics.

Solid cranks and pins of cast steel; nickel steel piston rods and wrist pins; cast steel crossheads; solid compressor frame, eliminating tie rods; accessibility of suction and discharge valves; method of stuffing box alignment;—are features of our standard construction, to which we call especial attention.

Telescopic Oilers and central oiling system are refinements which we furnish when required.

Built in various sizes from 20 tons refrigerating capacity and upwards, either belt or steam-driven, with simple or compound engines.

Prices on application to

YORK MANUFACTURING COMPANY, YORK, Pa., U. S. A.
Ice-Making and Refrigerating Machinery Exclusively

Represented in the Dominion by
CANADIAN ICE MACHINE COMPANY
MONTREAL, 324 Coristine Bldg.
WINNIPEG, 302 Donalda Bldg.
TORONTO, 163-167 Yonge Street

J. V. Jamison, President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

Change of Name

On and after September 1st, 1914

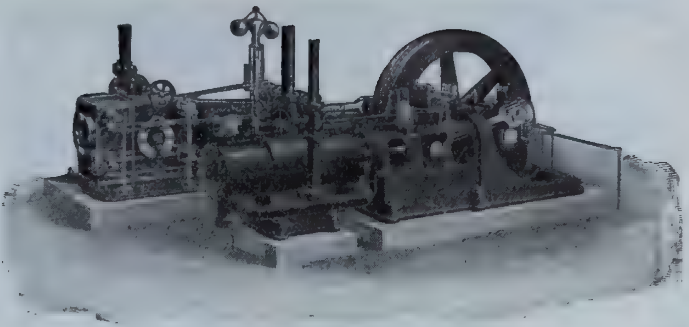
Jones Cold Store Door Co.

will change its corporate name and will thereafter be known as—

The Jamison Cold Storage Door Company

HAGERSTOWN, MARYLAND

No change whatever will be made in the organization or the business of the Company. The personnel of the management and the sales and shop force will be the same as it has been since 1907.



Arctic Ice Machines
in Canada

are creating sales wherever installed. Recently we placed in operation an Arctic Refrigerating Plant for the St. Regis Hotel, Winnipeg.

Next the St. Charles Hotel, Winnipeg, ordered a similar outfit.

We are now shipping an Arctic ice and refrigerating plant to the new Olympia Hotel, Winnipeg.

In ice factories, storage houses, etc., we can point to the same occurrence.

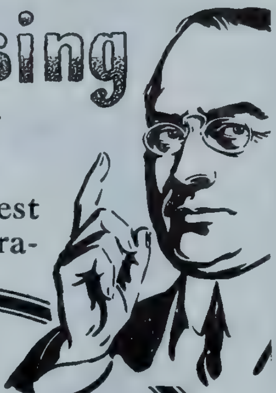
When an ice machine is its own best salesman—well, you want that kind.

Sizes from one-ton refrigeration upward.

Bulletin 1-P on request.

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

You're Losing Money



If you are not using the best insulation in your refrigeration plant.

You Can Stop That Loss At Once By Using Our

Corkboard Insulation

It is made of pure cork, and is recognized as the best insulation for cold storage and refrigerating purposes.

It is the only cork insulation that is made in Canada.

Write for full particulars.

Robinson Bros. Cork Co., LIMITED

HEAD OFFICE—803 LUMSDEN BLDG. TORONTO
FACTORY—
PORT COLBORNE, ONTARIO

THE H&C SAFETY

SAFETY FIRST!-

Economy, Durability, Efficiency

ALWAYS

This is the whole secret of the

"H. & C. Safety" Success

The strongest single proof of the "H. & C. Safety" Compressor's ability to give you a profitable year in—year out service is the list of growing, successful concerns using the "H. & C." System.

Our repeat orders for additional equipment to supply the increasing demand of our old customers—customers who are already operating one or more "H. & C. Safety" machines and know their strength, simplicity and capacity is a big business in itself.

And it's business we are particularly proud of—this re-order business. Because it proves absolutely that the "H. & C. Safety" has given a big "value received" or we would never have gotten the invitation to do it again.

Write for our booklet on "Cold Facts."

THE HUETTEMAN & CRAMER COMPANY

Manufacturers of
Refrigerating and Ice-Making Machinery

DETROIT MICHIGAN

Detroit Lubricators for every purpose

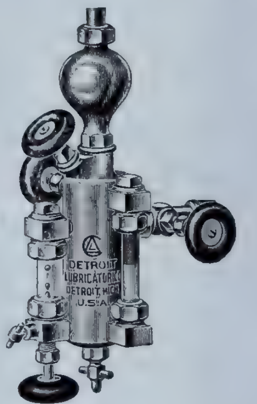
The Detroit line includes lubricators for service with every type of steam or gas engine, air compressor or machinery of any kind. One of these lubricators will enable you to eliminate every element of chance or uncertainty from the lubrication of your machine.

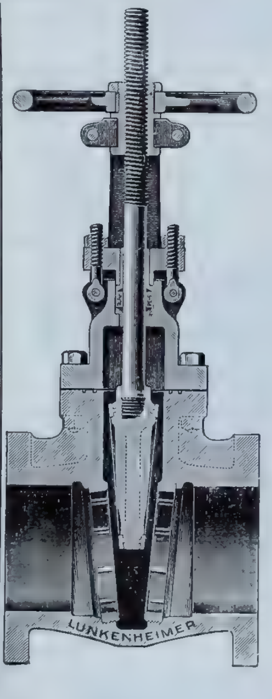
Every Detroit Lubricator is the product of scientific study of the conditions under which it operates and embodies every requisite for efficient, dependable, economical lubrication.

The big Detroit catalog tells about all the different kinds of Detroit Lubricators and gives valuable information on the lubrication of all kinds of machinery.

Write to-day for catalog G-58.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.





LUNKENHEIMER "VICTOR" GATE VALVES

Made in Medium and Extra Heavy **Bronze** Patterns; Standard, Medium, Heavy and Extra Heavy **Iron Body Bronze Mounted** Patterns, and in "**Puddled**" **Semi-steel** and **Cast Steel**; with Rising Stem and Yoke, or Stationary Stem; with or without By-pass, in all standard sizes and for various pressures.

The complete line of Lunkenheimer High-Grade Engineering Specialties includes, besides the above, **Bronze** and **Iron Body Bronze Mounted** Globe, Angle, Cross, Check, Non-return Boiler Stop, Throttle, Blow-off, Pop Safety, Relief, Screw Down Check Valves, etc.; Water Columns, Gauges and other Boiler Mountings; Whistles and Ground Key Work of all descriptions; Injectors, Ejectors, Lubricators and Lubricating Devices; Oil Pumps, Oil and Grease Cups; Gas Engine Specialties, etc.

Your local dealer can furnish them; if not, write us.

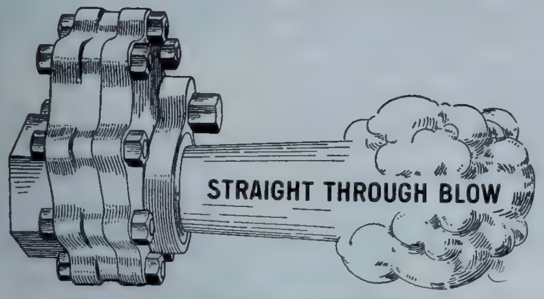
For a complete description of the entire line, see Lunkenheimer Catalogue No. 50. Write for a copy.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World
CINCINNATI, OHIO
NEW YORK CHICAGO BOSTON LONDON
6-43b

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!

WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiler & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

Pratt & Cady Valves

with Renewable Bronze Seat Rings

Those who are looking for a valve of the highest grade, one which they can rely upon to help in their "Safety First" campaign, will do well to choose the P. & C. line of gate valves, made in Brass and Iron from 1¼" up; they all have the same

Retaining Ring Construction

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. These seats can be renewed by removing the retaining rings with a suitable wrench made for the purpose, or other appropriate tool. The gate is a double-faced, wedge-shaped casting, with side grooves by means of which it slides on guides in the valve body.

Great pains are taken in the machining of all parts of these gate valves. Gauges are used on each part to insure their accuracy and interchangeability. The guides in the bodies are of equal thickness, and the wedges can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double-seated can be used with the pressure applied at either end.

For Superheat and High Pressure, Wet Steam and Oil, use Durabla Packing.

The Canadian Fairbanks-Morse Co., Limited

Montreal	St. John	Quebec	Ottawa	Toronto	Hamilton	Ft. William
Winnipeg	Regina	Saskatoon	Calgary	Edmonton	Vancouver	Victoria

Canada's Departmental House for Mechanical Goods

Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Fifth of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire and Cable Co.'s Limited, wires.

This picture shows the

C. P. R. HOTEL, CALGARY

This building was wired with "Adanac" Rubber Insulated Wire.

Architects and Engineers—E. & W. S. Maxwell, Montreal.

Electrical Contractors—Parker-Chase Electrical Construction Company, Calgary.

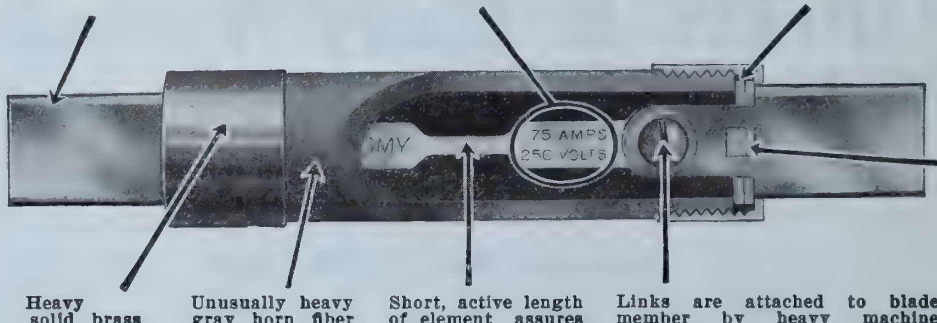
Address enquiries to nearest office

Northern Electric Company
LIMITED

Montreal	Winnipeg	Edmonton
Halifax	Regina	Vancouver
Toronto	Calgary	Victoria

Successors to
Imperial Wire and Cable Co., Limited.

Correspondence previously addressed to the Imperial Wire & Cable Co., Limited, at 611 C.P.R. Building, Toronto, and 902 Electric Railway Chambers, Winnipeg, should now be addressed to Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave. West, Winnipeg.


Round edge hard drawn copper.
Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.
This venting feature allows no fire to escape, even on severe short circuits.
MY
75 AMPS 250 VOLTS
Washer assembly centres, locks in position and aligns blades.
Heavy solid brass cap.
Unusually heavy gray horn fiber shell.
Short, active length of element assures uniform performance.
Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Unity Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

Do YOU Want This Chart File FREE?

THEN send us your order for a "Columbia" Recording Gauge **quick!** We are making this offer because we want the "Columbia" installed in **your** Boiler Room. For we know that you, as a practical Engineer, will appreciate the many advantages possessed by the "Columbia"—its wonderful durability and unfailing accuracy.

The **adjustable** and **removable** Recording Pen Arm — chart changing made easy.

The popular "Day and Night" border chart with wide record area—a clear and intelligent record.

The non-spilling and non-corrosive glass Recording Pens—a perfect record line.

And many other important features found only in

"Columbia" Recording Gauges

THOUSANDS of "Columbias" are in daily operation in Power Plants, large and small, in this country, the States and abroad. Ask any "Columbia" owner what he thinks of it. Or send for Catalog W 100—it will convince you that the "Columbia" is the Recorder for **you.**

A Handsome and Practical Chart File

And remember—**for a short time** we are offering a handsome and practical Chart File FREE with each "Columbia" Recording Gauge ordered. So, take action at once.

**The
Schaeffer & Budenberg
Mfg. Co.**

Makers of the "Columbia" Recording Thermometer and other Instruments for Power Plant Testing.

**Brooklyn, N.Y.
Chicago Pittsburgh**

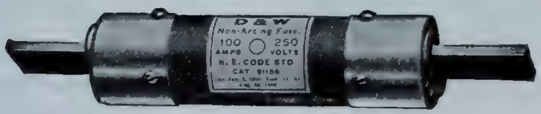
200

Safety First

Steam engine safety valves and electric fuses are two appliances that must attain the highest degree of accuracy to be dependable.

If a fuse fails to "blow" when the overload arrives an expensive motor may burn out.

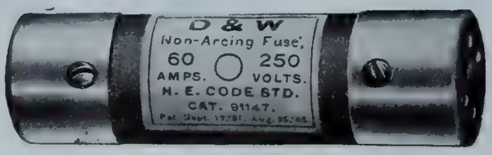
To avoid this danger it is important that you use



D & W Fuses

D & W Fuses have given absolute protection where other fuses have failed.

With a view to safeguarding valuable machinery and preventing possible loss of life give D & W Fuses a trial—we will furnish a sample.



This matter is too important to be delayed. Write to-day to our nearest house for full information.

Northern Electric Company
LIMITED

**Montreal Winnipeg Edmonton
Halifax Regina Vancouver
Toronto Calgary Victoria**

MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.

District of Montreal

Our Specialties are Built under Experienced Supervision.

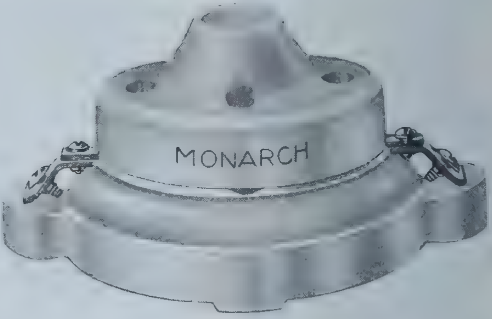
Try us when in the market for

Oil Switches, Disconnecting Switches, Switchboards, etc., etc.

No. 9402

No. 9134

No. 222



No. 950

NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

THE UNBREAKABLE KIND

Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN JR. COMPANY

Live Agents wanted all over Canada. 23-25 Dowd Street MONTREAL

SUNBEAM MAZDA LAMPS

You get more out of these Lamps than you pay for them

By giving three times the light at the same cost they increase efficiency of workmen and quantity and quality of production.

If your plant is already well lighted by carbon lamps you can get the same light at one-third the cost.

If you need a trifle more light, you can get twice the light at two-thirds the cost.

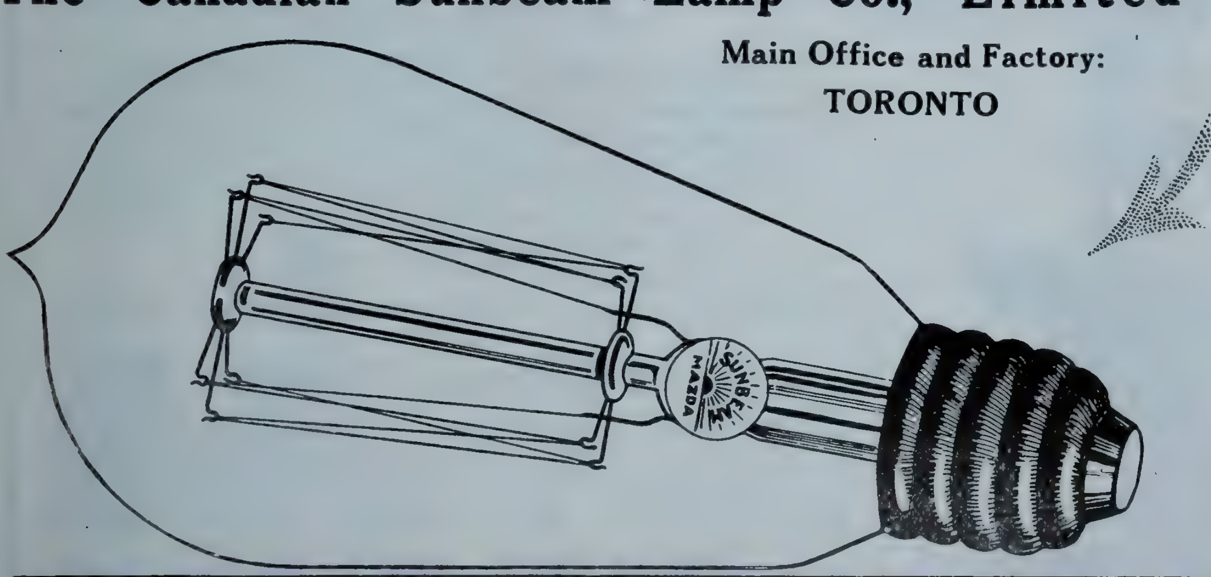
Sunbeam Mazdas burn in any position.

They are very durable. Vibration does not affect them. They don't discolor. Their use means an economical lighting system. Economize!

We ship quickly.

The Canadian Sunbeam Lamp Co., Limited

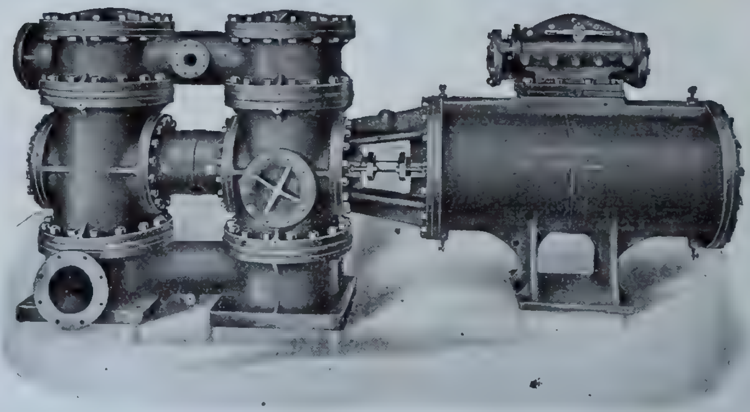
Main Office and Factory:
TORONTO



THREE TIMES THE LIGHT AT THE SAME COST

Tests Proved More than Claims of Bawden Pumps on Toronto Fire Tug

The Bawden Compound Pump installed by us on the steamer "Clarke" for fire service on the Toronto water front proved the Bawden pumps to be all and more than has been claimed for them regarding efficiency and service.



The Pump has:

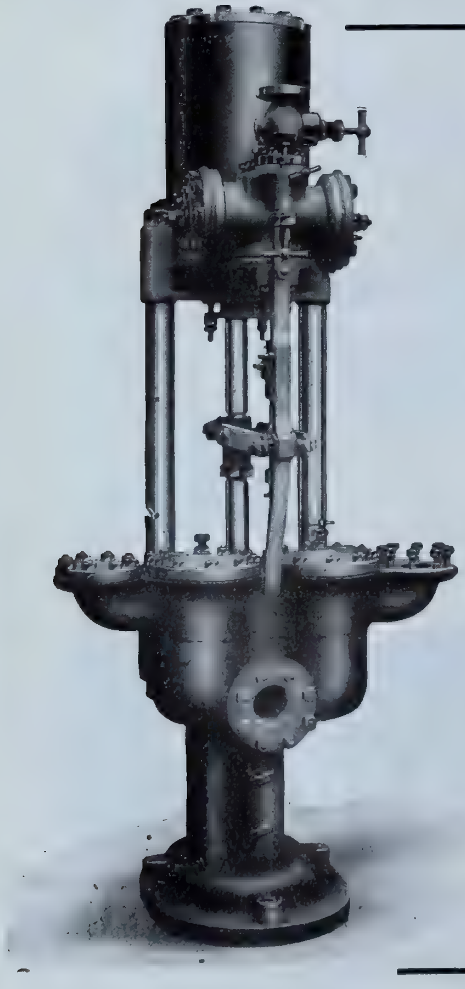
- 14" diam. High-Pressure Steam Cylinder.
- 24" diam. Low-Pressure Steam Cylinder.
- 12" diam. Water Cylinder.
- 20" Stroke.
- And is of the Group Valve Type.

On the tests made by Fire Chief Thompson at Centre Island on May 13th, the pump was operated by 80 H.P. boiler carrying 150 lbs. steam pressure and the pump delivered 1,000 U.S. Gallons per minute against 200 lbs. pressure and with two 750 feet lengths of 2½" fire hose fitted with 1¼" nozzles and delivered two streams 124 ft. high.

The results given, as in all Bawden installations, proved Bawden pumps to be all that is claimed for them.

THE BAWDEN MACHINE CO., LTD.

133 STERLING ROAD -:- -:- -:- -:- TORONTO, CANADA



"WEIR"

THE UNSURPASSABLE PUMP

THE GREATEST EFFICIENCY. THE GREATEST ECONOMY.

Over 50,000 now in use.

Feeding Upwards of 120,000,000 Horse-Power

The Largest Vessel in the World,
The Largest Battleship in the World,
The Most Powerful Battle Cruiser,
The Fastest Torpedo Boat Destroyer,
The Most Luxurious Yacht Afloat,
The Greatest Dredger,
Are all fitted with WEIR AUXILIARIES.

The largest and most up-to-date plants in Canada are all equipped with

Weir Feed Pumps

List of Canadian users sent upon application.

Send for catalogue No. 4.

SOLE AGENTS

PEACOCK BROTHERS

Montreal Vancouver

Hard pulls and rough usage can't damage this hose

It's practically indestructible in ordinary service. A crushing load of 300 to 800 lbs. to each four turns of its armor—or a direct end pull of 1,000 to 3,000 lbs. won't fracture

J-M Flexible Metallic Combination Hose

TWO HOSE IN ONE

It has an inner lining of high-grade rubber protected by an outer armor of interlocking metal spirals. Absolutely pressure-tight under all conditions. Can't kink or buckle. And can't be put out of service unless **both** inner tube **and** outer protecting armor are punctured.

When the inner tube wears out it can be renewed at a very small cost—a great economy. The metal armor will outwear many inner tubes.

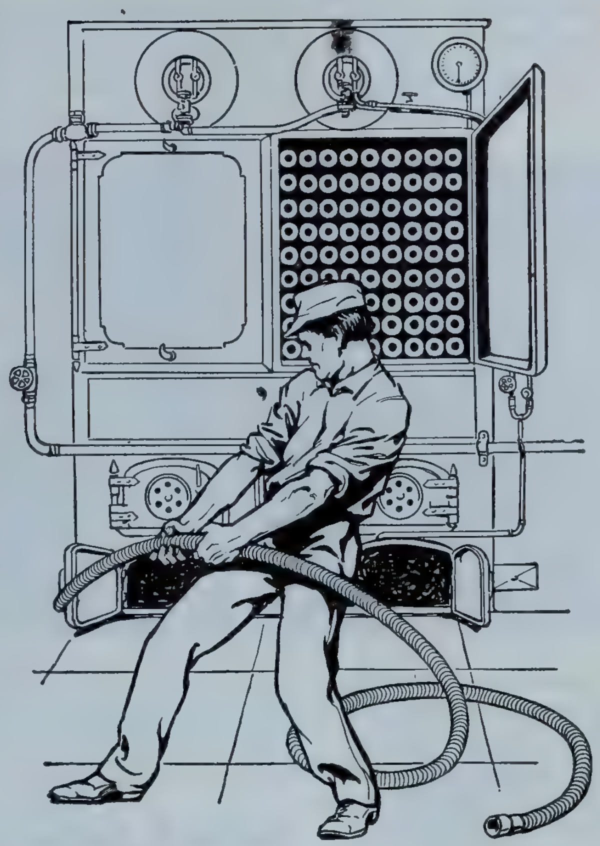
Write nearest Branch for Booklet describing many other advantages and economies.

**THE CANADIAN
H. W. JOHNS-MANVILLE CO., LIMITED**

Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Boiler Preservative; Conduit; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners; etc.

2036

TORONTO MONTREAL WINNIPEG VANCOUVER



MARSH and AMERICAN
Pumping Machinery
For Every Service

Marsh and American Pumps have a reputation for extreme simplicity combined with the highest efficiency. They are built for long continuous service and may be relied upon to do their work continuously, even under the most severe conditions. They cannot short-stroke, race or pound.

MARSH VACUUM PUMP.

A Complete Line of

Boiler Feed Pumps,	Deep Well Engines,
Vacuum Pumps,	Air Compressors,
Power Pumps,	Tank Pumps.

Our slogan: Simplex, not Duplex. "To be simple is to be great."

Ask for Bulletins.

MARSH BOILER FEED PUMP.

AMERICAN STEAM PUMP CO.

BATTLE CREEK, MICH.

CANADIAN AGENTS:
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman Machinery Co., Vancouver, B.C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited, Edmonton and Calgary

Electric **Boiler Scale Picking Machine,** Devoorde's Patent

Type F: For Fire-tube Boilers, etc., also for Picking the Grates Crusts, etc. For Cleaning Ship's Skins and for Sharpening Millstones.

Type R: For Cleaning the Tubes of Watertube Boilers, Steeptube Boilers, Economizers, Vacuum Apparatus, etc. (also suited for narrow and slightly curved tubes).

Type C: Combined installation.

Splendid Testimonials at Disposal! Great Advantages!

Approved where other Types Failed

Enormous Capacity!

Extraordinarily Simple Design

Design many hundred times approved, also under unfavorable boiler scale conditions.

OPERATION:

The three Pickers strike about 7200 times a minute and at the same time exert a tearing effect. The Pickers are pivoted and their action is elastically damped in a natural manner by the centrifugal force, they therefore operate free of all shocks, require very little power, do not fatigue, do not wear the edges of the pickers, **do not burr** and will also clean inaccessible parts.

Beware of inferior imitations.

Bader & Halbig, Halle a. Salle (Germany)

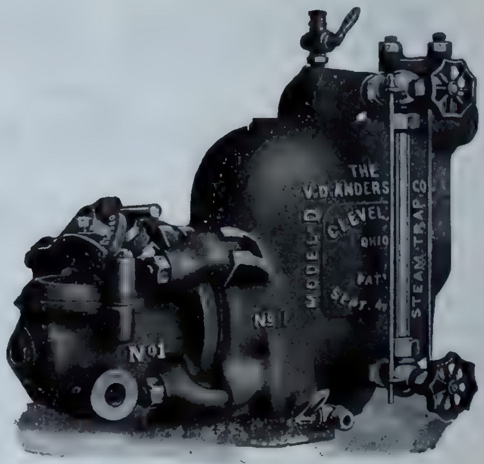
Enormous Capacity!

Easy Manipulation.

Small Consumption of Current.

In use with Railways, Shipbuilders, small and large Industrial Plants.

The Anderson Model "D" Steam Trap



Is a steady and continuous drainer, and automatically adjusts itself to any varying amounts of condensation within its capacity.

It prevents the trouble that usually occurs from faulty testing systems.

It is constructed so that you can change the Valve and Valve Seat from high to low pressure in five minutes, without unscrewing steam joints or pipe connections.

All parts are machined to solid gauges, insuring absolute accuracy, and are interchangeable.

A removable perforated strainer is part of the equipment. This prevents pieces of scale, packing lead, etc., from entering the trap.

Every trap is tested and inspected under boiler pressure by experts before leaving the Factory.

Every Anderson Model "D" is guaranteed.

Write for Booklet. It gives full details.

THE V. D. ANDERSON CO.

1935 West 96th St., CLEVELAND, OHIO

BRANCH OFFICES: 330 Manhattan Building, Chicago, Ill.; 6047 Jenkins Arcade, Pittsburg, Pa.; 3 Arch St., Philadelphia, Pa.; 212 Walnut St., Cincinnati, Ohio; 207 Union Trust Bldg., Baltimore, Md.; 91 High Street, Boston, Mass.

The advertiser would like to know where you saw his advertisement—tell him.

THERE are many methods of steam-raising just as there are many ways of wheat-raising, but there is only one BEST way. The one best way of steam-raising is to fire your boilers by means of "Bennis" machine stokers. You would scarcely attempt to dig by hand your wheat area! It is almost as futile to hand-fire your boilers and expect to raise a good supply of *cheap steam.*

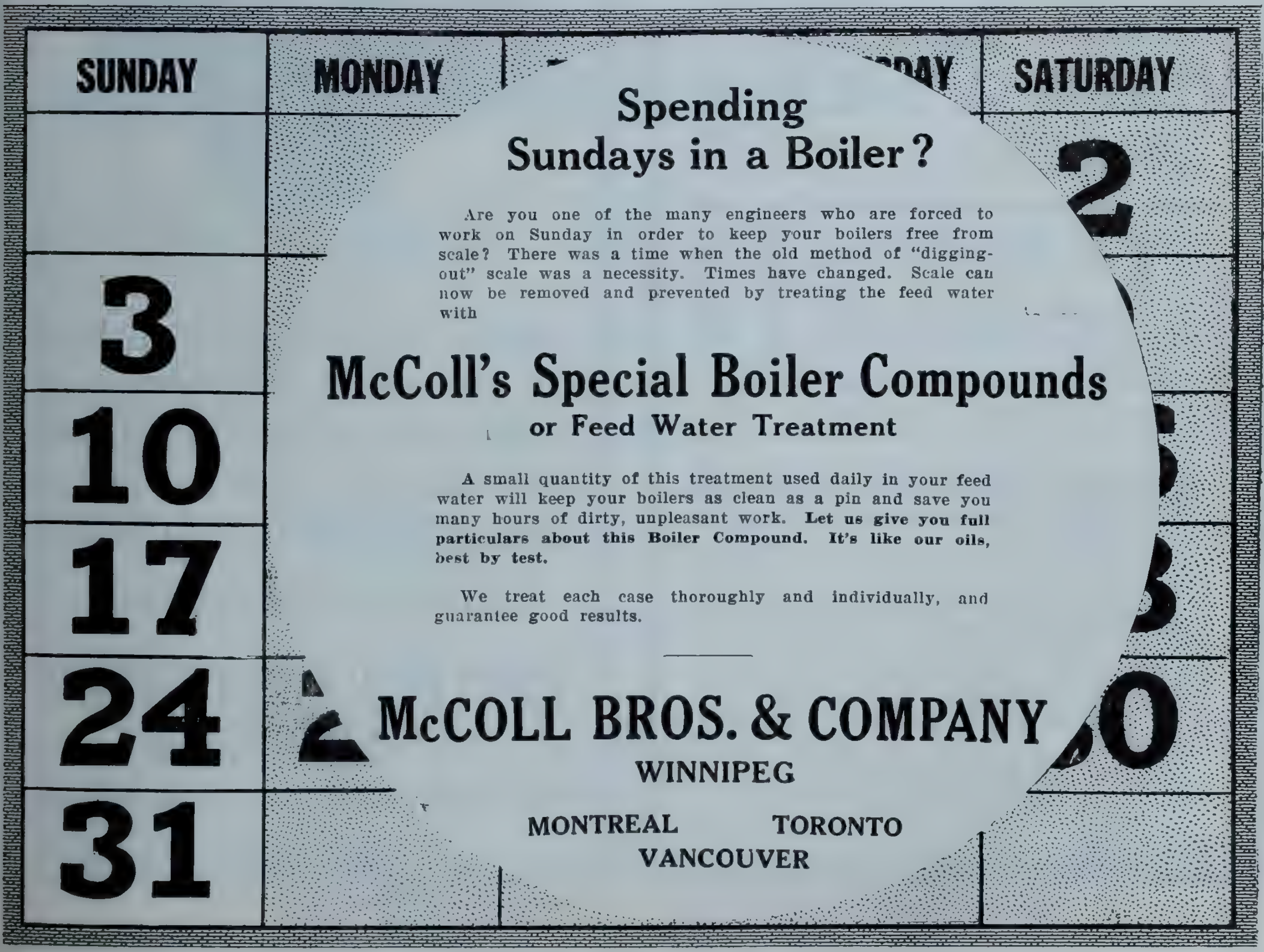
The "Bennis" Long-life Chain Grate Link which eliminates riddling and does not burn off.

"Bennis" Stokers mean cheap steam, and cheap steam means "Bennis" Stokers, and that is the whole of the story. Cheap steam means high boiler duty without smoke from low-grade fuels — *"Bennis" Stokers* mean high boiler duty without smoke from low-grade fuels.

Cheap Steam means a rapid response to a varying load, without detriment to the boiler. "Bennis" stokers mean a rapid response to a varying load, without detriment to the boiler.

Write for ***"Boiler House Economy and Cheap Steam"*** pamphlets, and full particulars to

G. H. TOD, **213 Manning Chambers Queen St. West** **TORONTO**
Winnipeg: 601 Union Bank Building



Spending Sundays in a Boiler?

Are you one of the many engineers who are forced to work on Sunday in order to keep your boilers free from scale? There was a time when the old method of "digging-out" scale was a necessity. Times have changed. Scale can now be removed and prevented by treating the feed water with

McColl's Special Boiler Compounds
or Feed Water Treatment

A small quantity of this treatment used daily in your feed water will keep your boilers as clean as a pin and save you many hours of dirty, unpleasant work. **Let us give you full particulars about this Boiler Compound. It's like our oils, best by test.**

We treat each case thoroughly and individually, and guarantee good results.

McCOLL BROS. & COMPANY
WINNIPEG
MONTREAL TORONTO
VANCOUVER

BOILER SETTING

B OILERS properly set, re-set and repaired.

O UR staff are experts in firebrick masonry.

I NSTALLATION which means efficiency.

L ASTING results a big consideration.

E NJOY the benefit of good workmanship.

R EPAIR bills are almost nil.

S ATISFACTION a great pleasure and asset.

IDEAL INCINERATORS

Most sanitary, cheapest, and best
method of destroying garbage and refuse.
Baby Incinerator for small towns.

Your inquiries respectfully solicited

The IDEAL INCINERATOR CO.
200 Gerrard St. East
TORONTO - - CANADA

CANADIAN ASSOCIATION
OF
STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

A. KASTELLA
Executive Secretary
STRATFORD, - - - ONTARIO

The STOKER for your Power Plant

Front View of Two DETROIT Stokers
Built in *all sizes* for *all types* of Boilers

Rear View of One DETROIT Stoker

Allow us to show you how to cut down your fuel and labor costs and eliminate the objectionable smoke, by using **DETROIT STOKERS.**

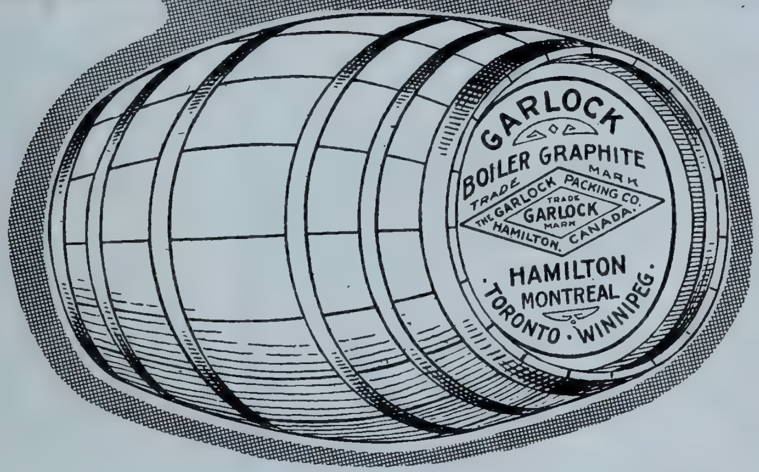
SEND FOR OUR ILLUSTRATED CATALOG

DETROIT STOKER COMPANY
DETROIT MICHIGAN

The Firm That Put the "phite" in Graphite

Garlock

BOILER GRAPHITE



One of the Most Successful Scale Fighters on the Market

It's the Method of Attack that Does the Trick

It circulates with the water through the boiler, will attack, soften and so disintegrate old scale that it may be easily removed, and will impart to the steel of the boiler a graphite finish on which new scale will not readily form. What little does form will be soft and so mixed with graphite as to be easily removed.

There is a mechanical—not a chemical action. It will not injure the tubes in the slightest degree.

By using Garlock Boiler Graphite you will increase the efficiency of your boiler, reduce fuel bills and easily clean your tubes.

To prove the effectiveness of this boiler graphite, we will send you a barrel on 60 days' trial. Keep it if you like it. If not satisfactory at the end of this trial period, return the unused portion at our expense and there will no charge for quantity used, nor expense to you in any way.

Fair Proposition?

The Garlock Packing Co., **HAMILTON ONTARIO**

MONTREAL TORONTO WINNIPEG CALGARY

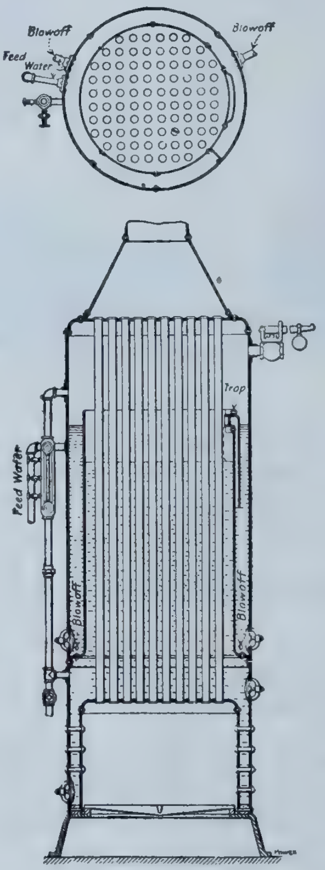
An Invention A fool-proof and scale-proof BOILER

THE ALEX. McKAY BOILER WORKS, Boiler Manufacturers of Montreal, are manufacturing a Scale-Proof Boiler which settles satisfactorily the scale problem. This firm, throughout its long experience, recognizes the fact that the only definite way to do away with this ever-present trouble was, not to depend upon the engineer's doubtful knowledge of treatment of hard waters or his skill and reliability in periodically cleaning boilers, but to make the boiler itself fool-proof.

The ingenious way in which this has been accomplished is shown in the accompanying illustration. The boiler is of the internally fired, vertical, full length tubular type and of the best design and, in addition to the usual attachments, is provided with a scale chamber. This arrangement consists of a flanged ring attached to the inside of the shell above the lower tube sheet. To the inner flange of the ring a casing is attached and extends a little above the normal water line of the boiler, thus forming an annular space between the outer shell into which the water enters.

On top of the side opposite the feed inlet is cut a notch or weir; over this notch a hood is placed which extends to the level of the top of the chamber and 15 inches below the top of chamber, so that only pure water can flow over into the tube chamber and come into contact with the heating surface. The process is as follows: The feed water enters and fills the scale chamber to the point of overflow into the boiler. The capacity of this space is proportional to the size of the boiler and is sufficient to allow the complete precipitation of all scale-forming material before the water goes to the boiler proper. While in the scale chamber its temperature is raised to that of the steam, which is usually above 300 F. The carbonates are mostly precipitated at 200 F. and the sulphates at 280 F. in the form of a soft sludge, which is periodically blown off at the bottom of the chamber and cannot become baked hard as it would if in contact with the heating surface or the hotter parts of the boiler.

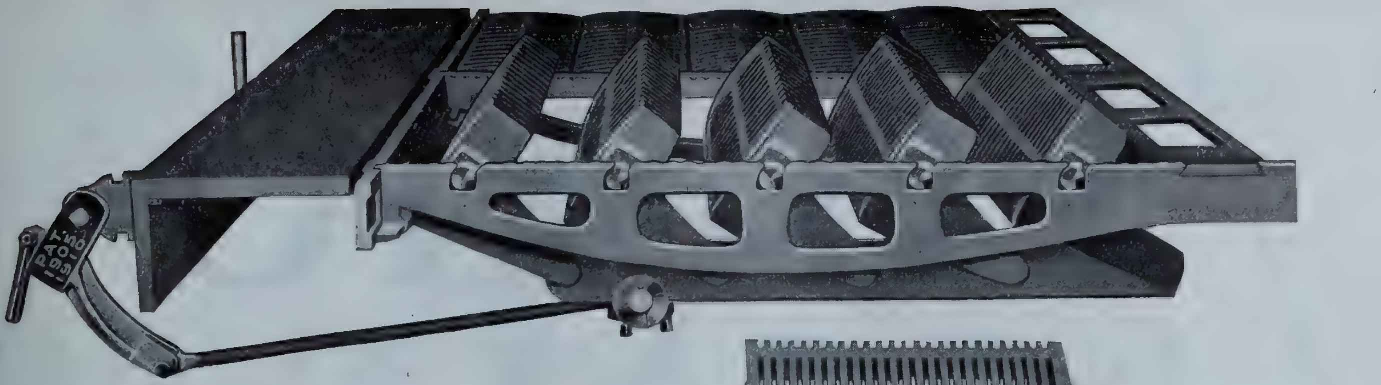
The success of this simple arrangement after years of use has been much greater than anticipated when it was first put upon the market. As a test, 20 lbs. dry earth, 20 lbs. lime, and 10 lbs. plaster of Paris, making a mixture like milk, was fed into the boiler, and after shutting down all the solid matter was found in the scale chamber.



Engineers are beginning to realize that the vertical, full length tube boiler, made sufficiently high so as to give a large heating surface, is the best boiler. The tubes in such a boiler give effective heating surface from the crown sheet of the furnace to the top head of the boiler, inasmuch as the whole inside surface of the tubes are in direct contact with the hot gases from the furnace. Contrasted with the horizontal fire and water tubular boilers, it will be seen that the conditions are not the same, as in either of these type of boilers only that portion of the tubes in contact with the heat from the furnace is effective heating surface. The amount of heating surface available for the superheating of steam in the vertical, full length tube boiler, makes same very economical. The old question will arise amongst engineers, that vertical, full length tube boilers have to be cleaned the same as all other types and, that in raising steam again with only cold water in the boiler, the top ends of the tubes may be overheated, but remember, with our Scale-Proof Boiler, you don't have to blow your boiler down, as you have to do in all other cases; you simply open the Scale chamber, blow off once a day, and blow 'all scale-forming matter out, boiler in meantime being under full head of steam.

The value of the Scale-Proof feature can hardly be fully realized, particularly when applied to portable machinery which is handled by all types of engineers and is subject to all kinds of water conditions. The saving of coal and all materials and apparatus for the treatment of hard water, as well as the labor of scraping out scaly boilers, are as much appreciated by the fireman as by the owner of the plant. The saving of fuel, feed water purifying apparatus and compounds alone ought to recommend such a boiler as a time and money saver.

The manufacturers of this patented boiler, The Alex. McKay Boiler Works, whose plant and offices are at 1194 Demontigny Street East, Montreal, have had a long and successful career as boiler builders, and invite inquiries and will be pleased to give further particulars, prices, etc., to interested parties. Address all correspondence to The Alex. McKay Boiler Works, Boiler Dept., 1194 Demontigny Street East, Montreal, Que.



CYCLONE

Shaking and Dumping Grates

effect a great saving in fuel because with them screenings or any grade of hard or soft coal can be burned with results equal to that of the best.

This construction means highest efficiency and long life.

There is an **exclusive shaking feature** possessed by no other Grate Bar. It means more vigorous and effective shaking, which is invaluable, and can be explained by any user.

The 68% air space and 90% underdraught means very complete combustion.

Any of the users listed herewith will be glad to tell you all about the "Cyclone." Why not write them?

We are prepared to instal our Grates in the Plant of any respectable Company on **30 days' trial.** If satisfactory, we will expect payment as agreed on, and if not, we will remove the Grate from the premises without cost or lost time to the purchaser.

Beware of imitations — they won't give the service.

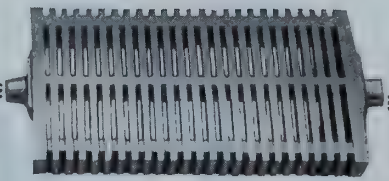
The Canadian Steam Boiler Equipment Co., Limited

Sole Manufacturers for Canada

20 McGee St., Toronto, Ont.
Phone Gerrard 3660

AGENTS.

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street. HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, [illegible] Iron Works. PORT ARTHUR, Northern Agency Co.



Partial list of users of "Cyclone" Grates

Prices, Ltd., Brick Makers (64 sets)
Toronto Electric Light (18 sets)
Price & Cummings (48 sets)
J. Simpson & Son (4 sets)
Home Life Building (2 sets)
Massey-Harris Co. (5 sets)
Traders Bank Bldg. (3 sets)
Consumers Gas Co. (8 sets)
Harris Glue Works (4 sets)
TORONTO
Walmer Rd. Baptist Church (2 sets)
Georgian Bay Milling Co., Meaford.
Penman's, Ltd., Paris, Ont.
Court House, Hamilton.
City Hall, Hamilton.
Canadian Hart Wheel Co., Hamilton.
London Street Railway, London.
McClary Mfg. Co., London.
Matthews-Laing, Peterboro'.
Echo Milling Co., Gladstone, Man.
Auburn Woolen Mills, Peterboro'.
Dale Estate, Brampton, Ont.
Miller Bros., Toronto.
Cornwall & York Cotton Mills, St. John.
Berlin Electric Light Co., Berlin.
F. Krantz Spring Brew'y Co., Hamilton
Canadian Canners in St. Davids, Simcoe, Fonthill, Delhi, Meaford, Hamilton, etc.

POTATO SCALE

BOILER CLEANSER

Survival of the fittest

Potato Scale stops boiler-destructing and fuel-wasting as soon as Potato Scale Boiler Compound comes in contact with it.

The two cannot live in the same boiler, and the latter is the stronger.

While this Compound, used in smaller quantities, proves disastrous to scale, it has not the power to cause the slightest injury to tubes or fittings.

We treat each case individually, and guarantee satisfactory results.

We'll be pleased to send a trial keg.

Satisfaction or no pay, and to put you in touch with users.

Agents for Boiler Graphite

C. C. SNOWDON

Refiner, Importer and Manufacturer of

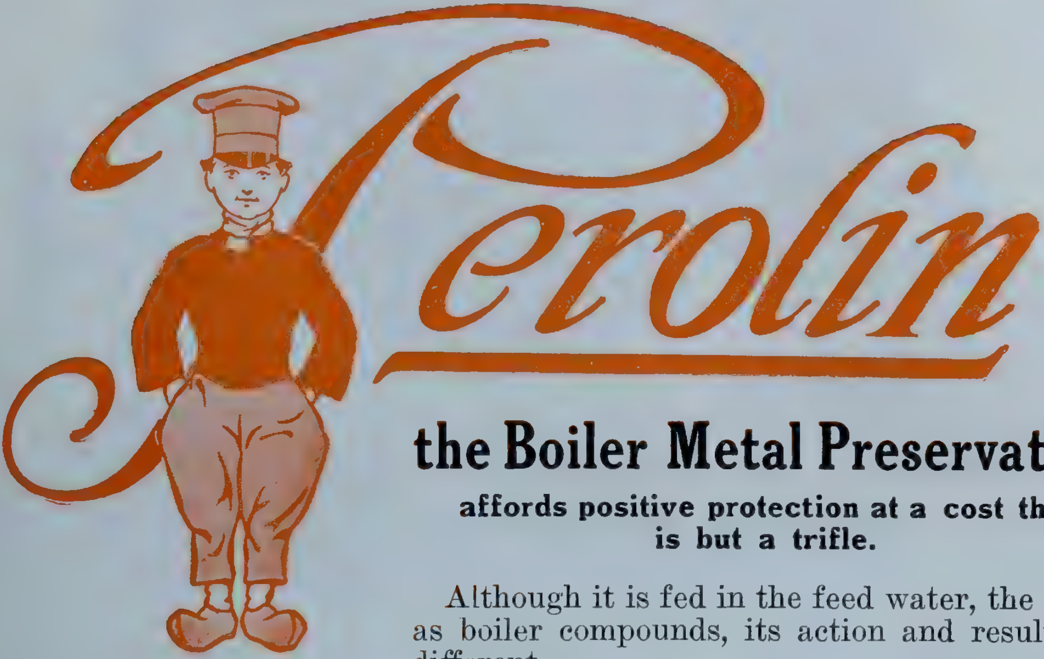
Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

1810-1840 11th STREET East, (Corner Burns Avenue)
CALGARY, ALBERTA

Branches: Vancouver, Edmonton, Winnipeg

Telephone 5318
Telephone 5217
P. O. Box 1384

Boiler destructing ingredients prevail in all feed water— therefore it is practical economy to protect the boiler.



the Boiler Metal Preservative

affords positive protection at a cost that is but a trifle.

Although it is fed in the feed water, the same as boiler compounds, its action and result are different.

If the tubes are coated with scale, Perolin works through the cracks in the latter (which are caused by expansion and contraction of boilers) to the metal—and works along the metal, loosening the scale mechanically so that it can be readily washed out.

Perolin forms a preservative film over the tubes and shell, when old scale is removed. This film prevents scale-forming substances from adhering, and prevents pitting, corrosion, etc.

The preservative film is an efficient transmitter of heat; it keeps the boiler at full rated capacity, and as a result an enormous saving in fuel is effected.

The Bureau of Inspection, Tests and Consultation says that **Perolin will not injure metal.** Will send you a copy of their letter if you wish.

By using Perolin you will save much time and labor.

It is used in over 20,000 plants in Canada, United States and Mexico, and throughout Europe—everywhere the demand is rapidly growing because Perolin always makes good.

We'll ship you, freight prepaid, a sufficient quantity to test for sixty days. REMEMBER — if not satisfied with the result—return what you have left, and the amount used will cost you nothing.

GUARANTEE

We guarantee PEROLIN, the German Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

Perolin Company of Canada, Limited

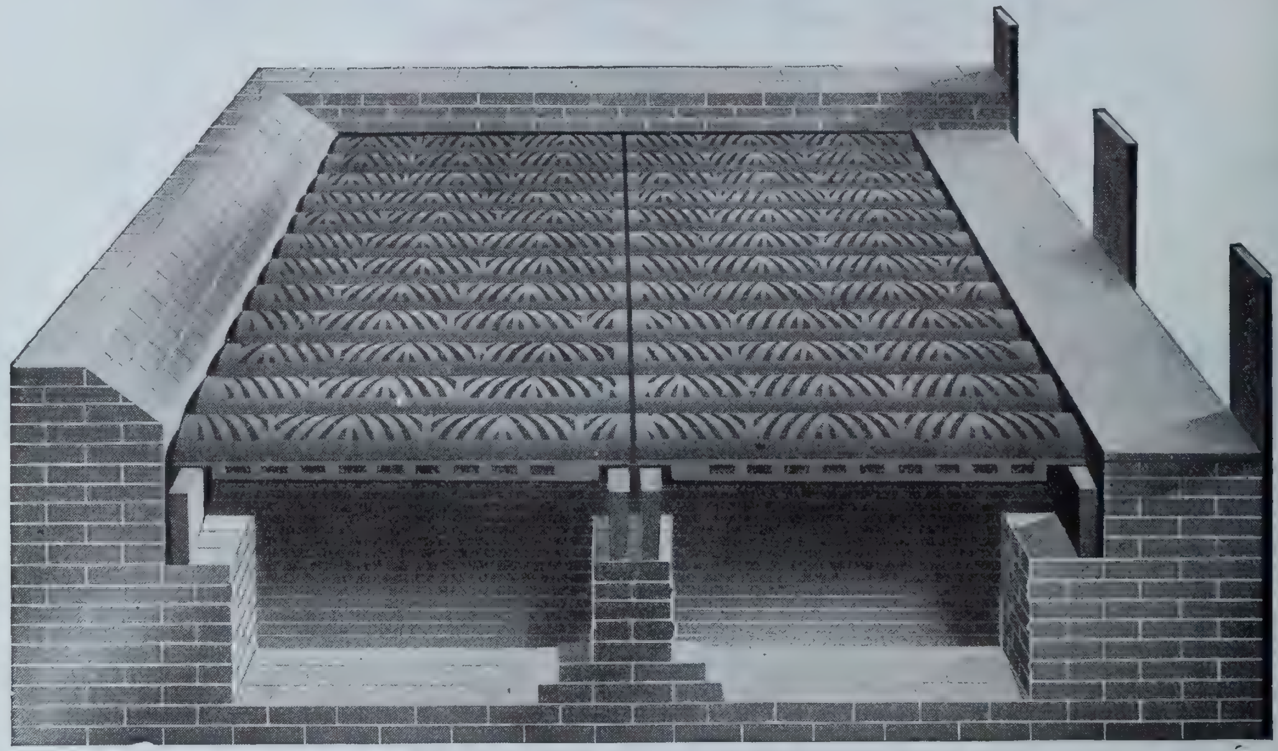
76 Adelaide St. West, Toronto, Ont.

Quebec Agents: Burroughs, Joyce & Co., 30 St. John Street, Montreal.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

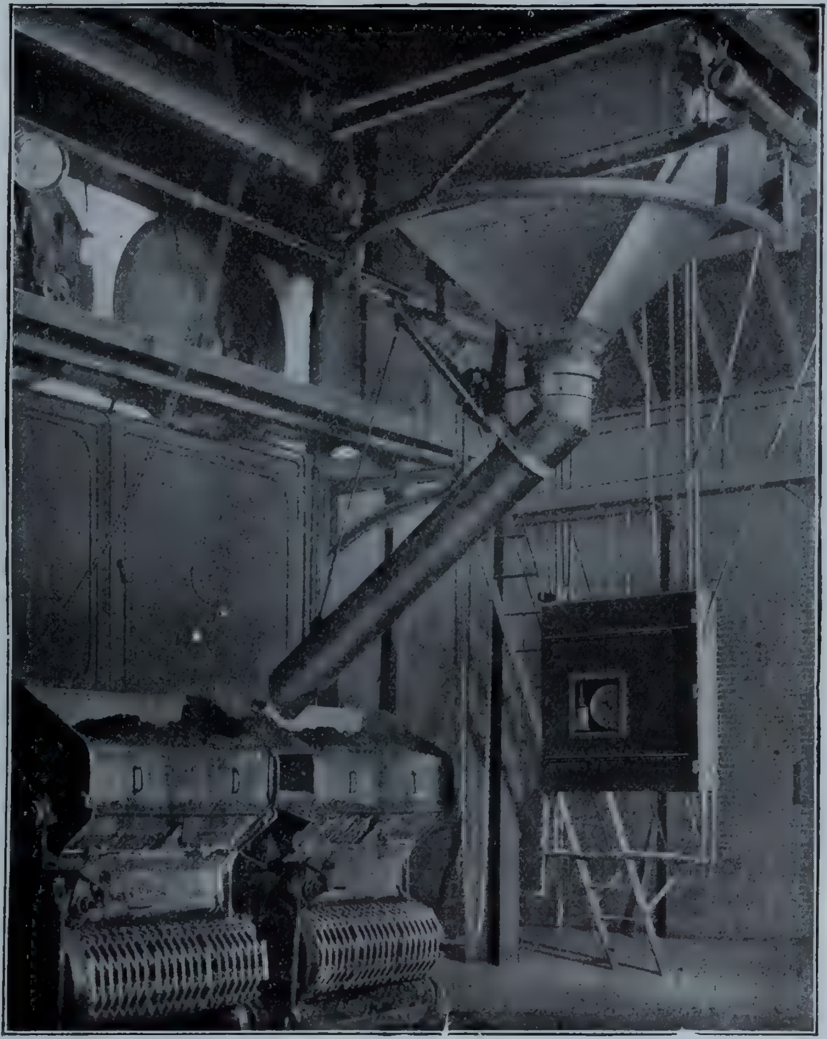
FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.



Pounds of Coal per H. P. per Hour

You must know how many lbs. of coal you burn each day in order that you may keep your power cost down to a minimum.

A Fairbanks Scale

will tell you quickly and accurately. The above illustration shows the application of a one-ton Fairbanks Suspension Coal Scale, with quick-weighing dial and mounted on a trolley.

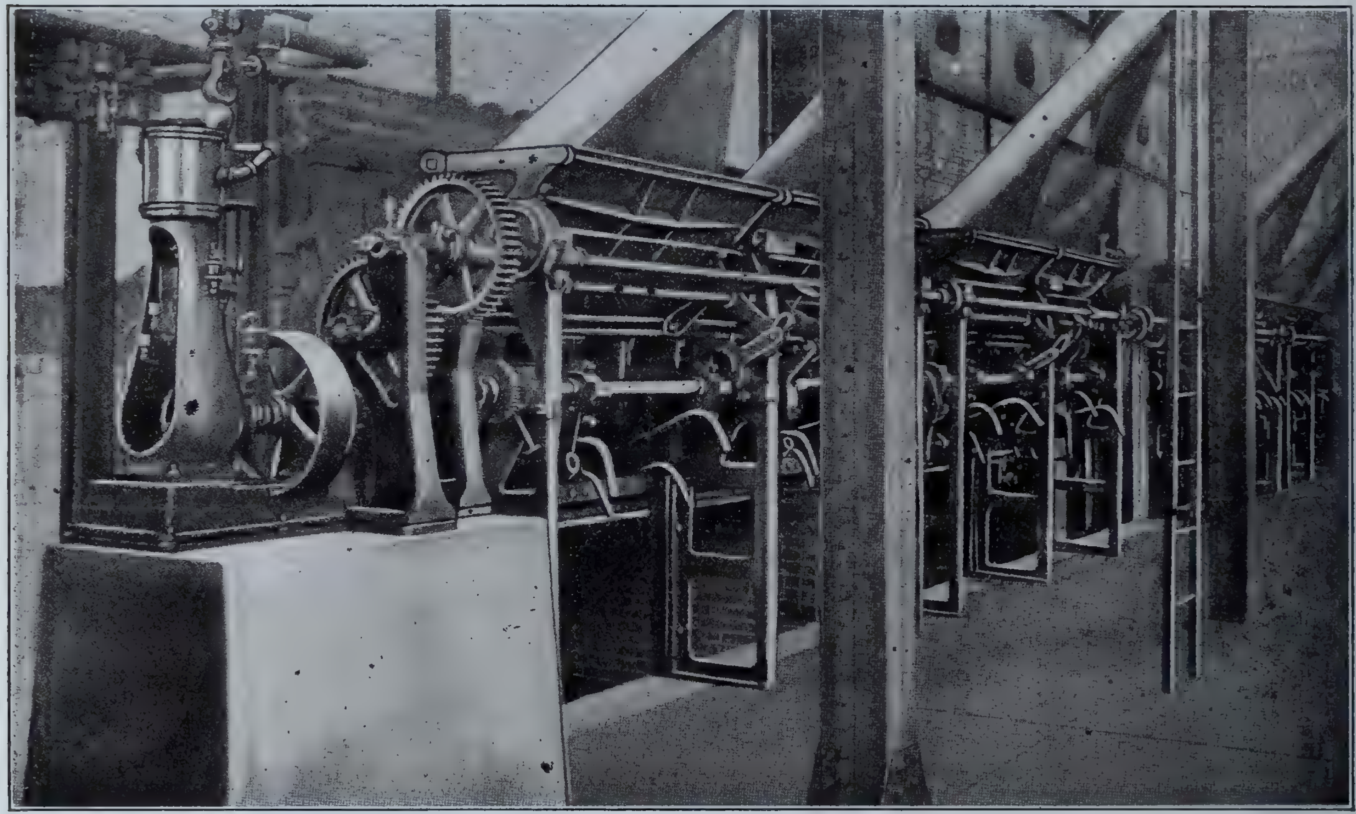
Let us know the conditions in your power house and we will advise you as to the best method of handling your weighing problem.

The Canadian Fairbanks-Morse Co., Limited

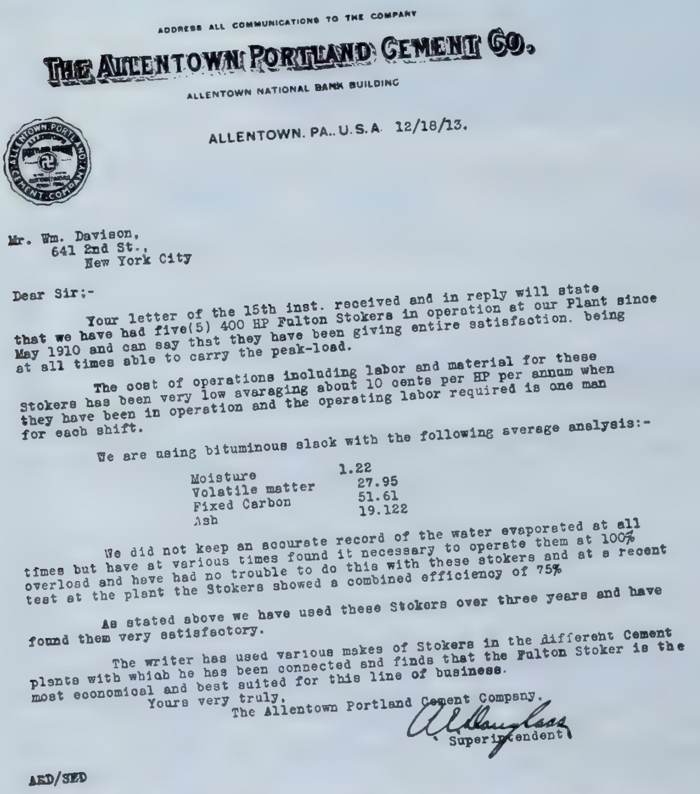
Montreal St. John Quebec Ottawa Toronto Hamilton Ft. William
Saskatoon Calgary Edmonton Winnipeg Regina Vancouver Victoria

Canada's Departmental House for Mechanical Goods

FULTON WATER-COOLED MECHANICAL STOKERS



5-400 H.P., No. 12010, Type "H," Fulton Water-Cooled Mechanical Stokers installed in the Plant of The ALLENTOWN PORTLAND CEMENT COMPANY Evansville, Pa.



ADDRESS ALL COMMUNICATIONS TO THE COMPANY
THE ALLENTOWN PORTLAND CEMENT CO.
ALLENTOWN NATIONAL BANK BUILDING
ALLENTOWN, PA., U.S.A. 12/18/13.

Mr. Wm. Davison,
641 2nd St.,
New York City

Dear Sir;-

Your letter of the 15th inst. received and in reply will state that we have had five(5) 400 HP Fulton Stokers in operation at our Plant since May 1910 and can say that they have been giving entire satisfaction. being at all times able to carry the peak-load.

The cost of operations including labor and material for these Stokers has been very low avaraging about 10 cents per HP per annum when they have been in operation and the operating labor required is one man for each shift.

We are using bituminous slack with the following average analysis:-

Moisture	1.22
Volatile matter	27.95
Fixed Carbon	51.61
Ash	19.122

We did not keep an accurate record of the water evaporated at all times but have at various times found it necessary to operate them at 100% overload and have had no trouble to do this with these stokers and at a recent test at the plant the Stokers showed a combined efficiency of 75%

As stated above we have used these Stokers over three years and have found them very satisfactory.

The writer has used various makes of Stokers in the different Cement plants with which he has been connected and finds that the Fulton Stoker is the most economical and best suited for this line of business.

Yours very truly,
The Allentown Portland Cement Company.
A L Douglass
Superintendent

AED/SED

NOTE THE RESULTS

Efficiency:—75% Combined efficiency Boiler and Stoker.

Capacity:—100% continuous overload secured at any time desired, or 800 horse-power per unit.

Repairs:—Four of these units have been in continuous operation 24 hours per day, and 365 days per year, for 3 years and 9 months. This is equivalent to 10.95 years' service of 3000 hours each. 17,520 H.P. years, repairs $600 from all causes (material and labor) or **2.92 cents** per Horse-Power per Year.

THE LAST WORD IN STOKER DESIGN

MANUFACTURED IN CANADA BY

THE HARE ENGINEERING COMPANY LIMITED

Head Office, TORONTO. E. Laurie Co., 243 Bleury St., Montreal, Quebec Representatives

Jones Underfeed Stokers

In Pulp and Paper Mills

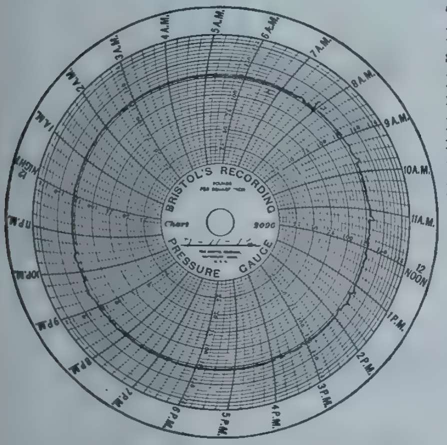
have made possible fuel savings never before credited any system of firing.

Take as illustration the boiler plants of the Minnesota & Ontario Power Company, Fort Frances, Ontario, and International Falls, Minnesota:

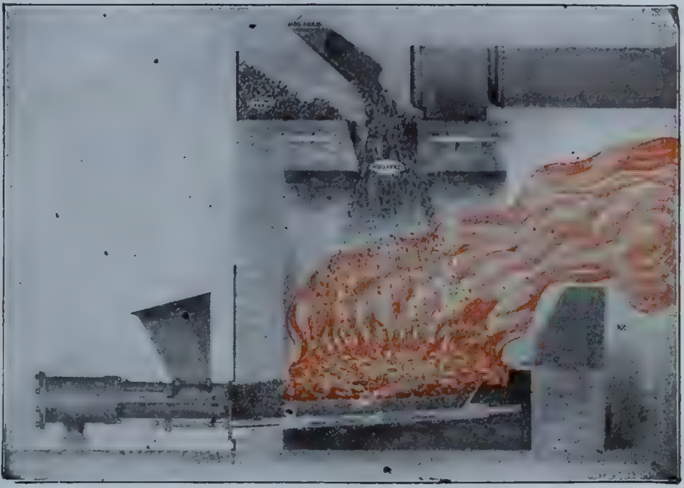
Before the stokers were installed in the latter plant 3,000 tons of coal were required each month, costing them nearly $3.50 per ton. Since installing Jones stokers, under normal conditions, only five tons of coal are burned per week, the balance of heat required being obtained from "hog feed" and paper mill refuse—heretofore a waste product, entailing an enormous and continual expense for its disposal.

The saving is, therefore, 3,000—22=2,978 tons @ $3.50=$10,423.00 per month, or more than $300.00 per day.

The equipment is entirely automatic, and should a drop of a few pounds occur in the steam pressure, or should there be a shortage in the supply of refuse, the stokers immediately feed in more coal and the blower equipment supplies more air, so that the normal pressure is promptly restored. If for any reason the "hog feed" is temporarily abandoned, the stokers automatically make the change over, carrying the load with coal alone.



The steam chart here illustrated shows the constant pressure that is maintained in this plant burning "hog feed" or refuse mixed with a small proportion of coal.



Arrangement of Jones Underfeed Stokers in Dutch Oven for burning paper mill refuse in conjunction with coal.

If you have refuse to burn or if you have a steam plant to fire on coal alone, you need a Jones Stoker equipment just as much as did any of the following Paper Mills having boilers Jones Stoker equipped:

Partial List

	Boiler H.P.
St. Lawrence Pulp & Lumber Corp'n., Chandler, P.Q.	3,000
E. B. Eddy Co., Hull, P.Q.	2,700
Kinleith Paper Co., St. Catharines, Ont.	450
Minnesota & Ontario Power Co., Fort Frances, Ont.	1,200
Minnesota & Ontario Power Co., International Falls, Minnesota	2,400
Mullen Bros. Paper Co., St. Joseph, Mich.	450
Traders' Paper Company, Lockport, N.Y.	800
Brown Paper Company, Ft. Madison, Ia.	300
Hollingsworth & Whitney Co, Waterville, Me.	4,650
West Virginia Pulp & Paper Co., Covington, Va.	2,750
West Virginia Pulp & Paper Co., Williamsburg, Pa.	2,500
West Virginia Pulp & Paper Co., Mechanicsville, N.Y.	6,600
West Virginia Pulp & Paper Co., Tyrone, Pa.	2,140
Dells Paper & Pulp Co., Eau Claire, Wis.	1,800
Monroe Binder Board Co., Monroe, Mich.	600
Case Bros., Highland Park, Conn.	450
Rhinelander Paper Co., Rhinelander, Wis.	1,500
Ticonderoga Pulp & Paper Co., Ticonderoga, N.Y.	2,460
J. & J. Rogers Co., Ausable Forks, N.Y.	1,637

Jones Underfeed Stoker Co., Limited

National Trust Building, Toronto

THE MURPHY AUTOMATIC SMOKELESS FURNACE

Home of the Murphy Automatic Smokeless Furnace, largest plant in the world devoted exclusively to the manufacture of "Automatic Furnaces."

Users of MURPHY FURNACES have the REPEAT ORDER HABIT; for example: CANADIAN KODAK CO., LTD., Toronto, Ont.

FIRST ORDER, Oct., 1908; SECOND ORDER, Apr., 1914; 8 furnaces, 1,720 H.P. The parent Company—EASTMAN KODAK CO., Rochester, N.Y., has had eight years' experience; FIRST ORDER, 1906; FOURTH ORDER, Feb., 1911, 20 furnaces, 6,700 H.P.

LAURENTIDE PAPER CO., LTD., Grand Mere, P.Q.
FIRST ORDER, 1905; FOURTH ORDER, May, 1912; 14 furnaces, 4,300 H.P.

BELGO CANADIAN PULP & PAPER CO., LTD., Shawinigan Falls, P.Q.
FIRST ORDER, 1910; FOURTH ORDER, March, 1914; 8 furnaces, 2,470 H.P.

HARRIS ABATTOIR CO., LTD., Toronto, Ont.
FIRST ORDER, 1909; THIRD ORDER, Dec., 1912; 6 furnaces, 1,650 H.P.

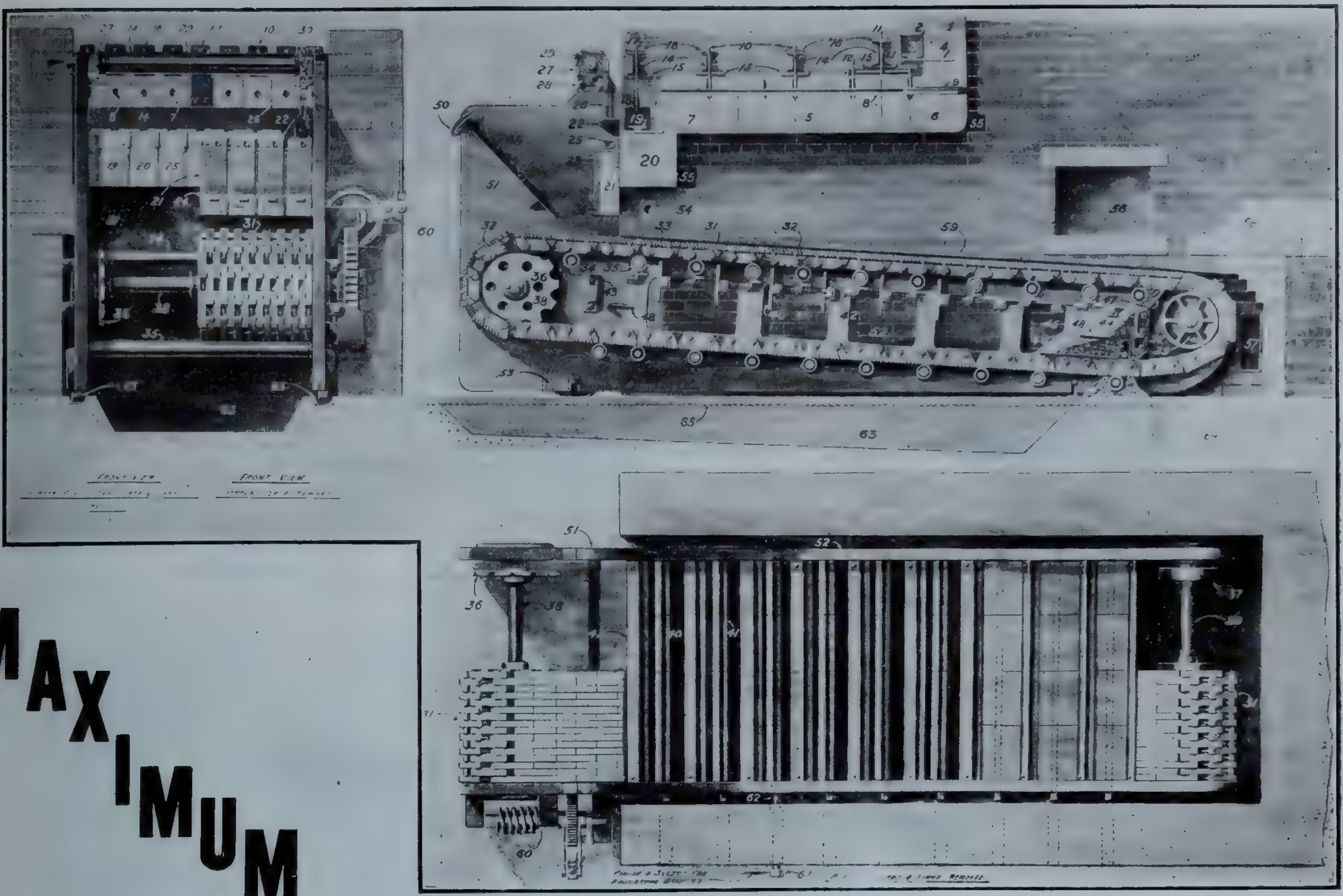
ST. LAWRENCE STARCH CO., LTD., Port Credit, Ont.
FIRST ORDER, 1908; THIRD ORDER, June, 1913; 8 furnaces, 1,460 H.P.

Determine 20 per cent. of your annual coal bill and you will approximate the dividend earning power of money investment required for MURPHY FURNACES.

Complete descriptive catalogue upon application.

Murphy Iron Works

Detroit, Mich. **Buffalo, N.Y.**



MAXIMUM FURNACE EFFICIENCY

PERFECT IGNITION AND SMOKELESS COMBUSTION.

Our high arch insures free flame propagation, which raises the temperature of the short ignition arch, and reflects heat where it is required for raising the temperature of the coal to its burning point. These conditions preclude the possibility of coal entering the furnace a foot or more without catching fire, a failing common to many chain grate installations. The high temperature at front of furnace affords early opportunity for burning the smoke-producing gases which are evolved, and they leave the furnace colorless.

PROPER AIR DISTRIBUTION.

By means of dampers under the chain, air can be admitted to any portion of the grate desired, and thus any load from a banked fire to 250 per cent. of boiler rating can be carried without any excess of air.

ADJUSTABLE COAL FEED.

The stoker can be run at five speeds, and in addition the depth of full bed can be varied by means of a movable gate.

MINIMUM UPKEEP.

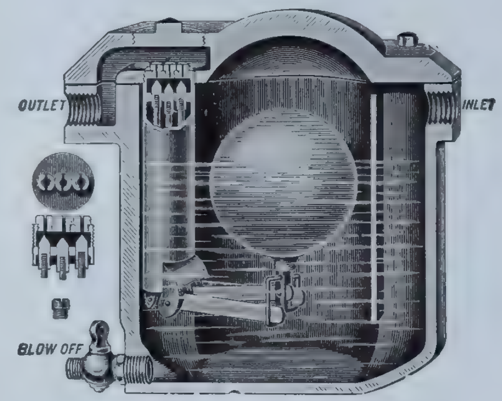
The links are of a length proven best for resisting the destructive action of the fire. A broken link could, however, be easily and quickly replaced by a repair link. The chain rods are cylindrical, and expose all their surface to equal wear. Round rods eliminate the danger of links becoming locked in a cramped position.

Whether your plant is large or small, the Illinois Chain Grate Stoker means practical economy and maximum results.

Write for full details.

Illinois Stoker Company

Alton, Illinois



Wright

"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

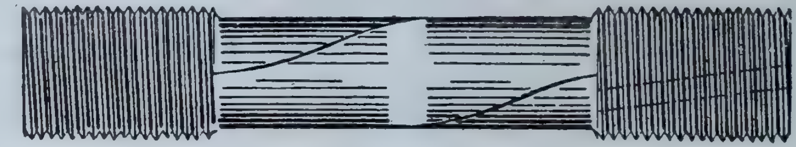
Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited
15 Ottawa Street, MONTREAL
TORONTO WINNIPEG ST. JOHN, N.B.

The AMERICAN STAYBOLT



Requires no special preparation of the boiler.
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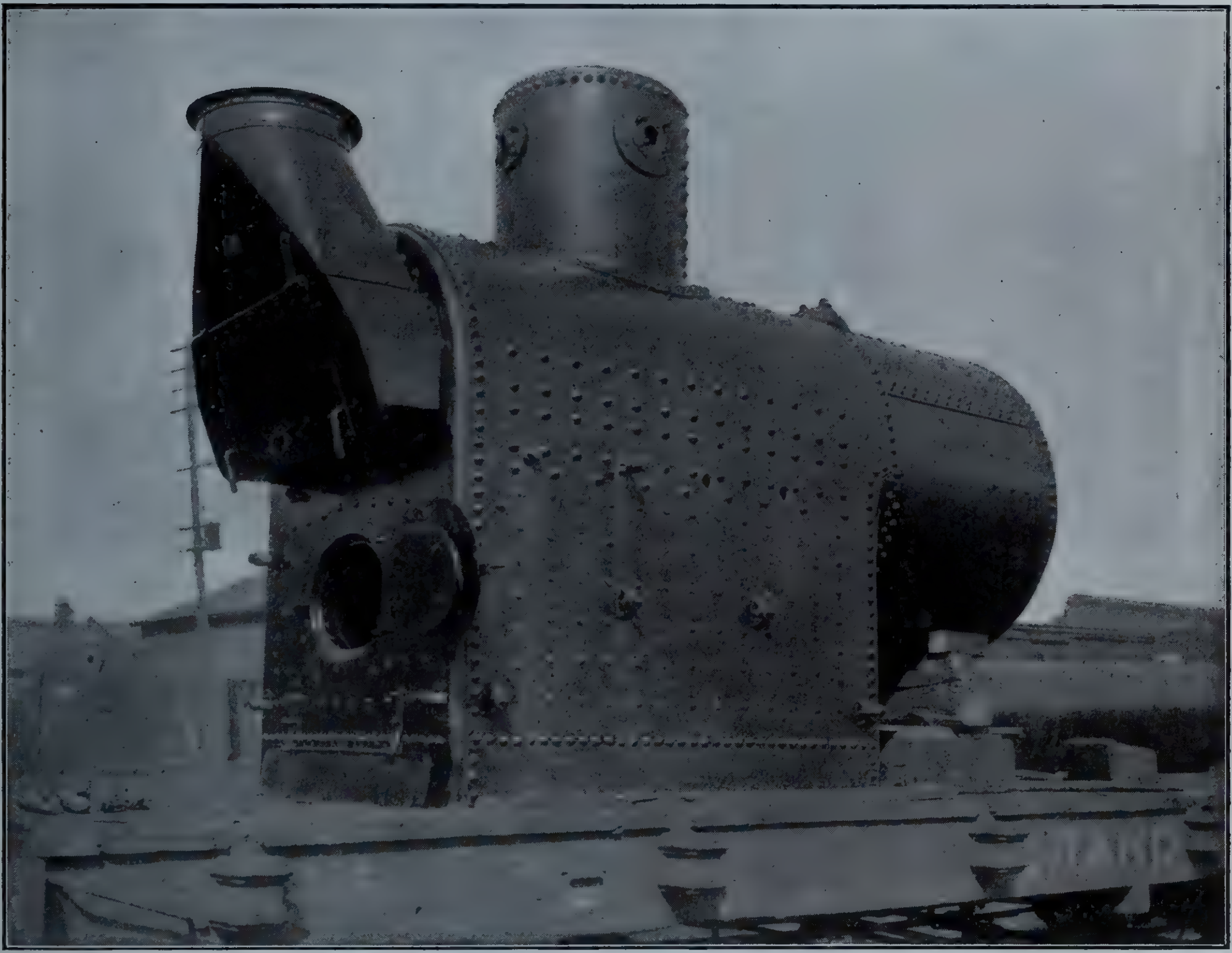

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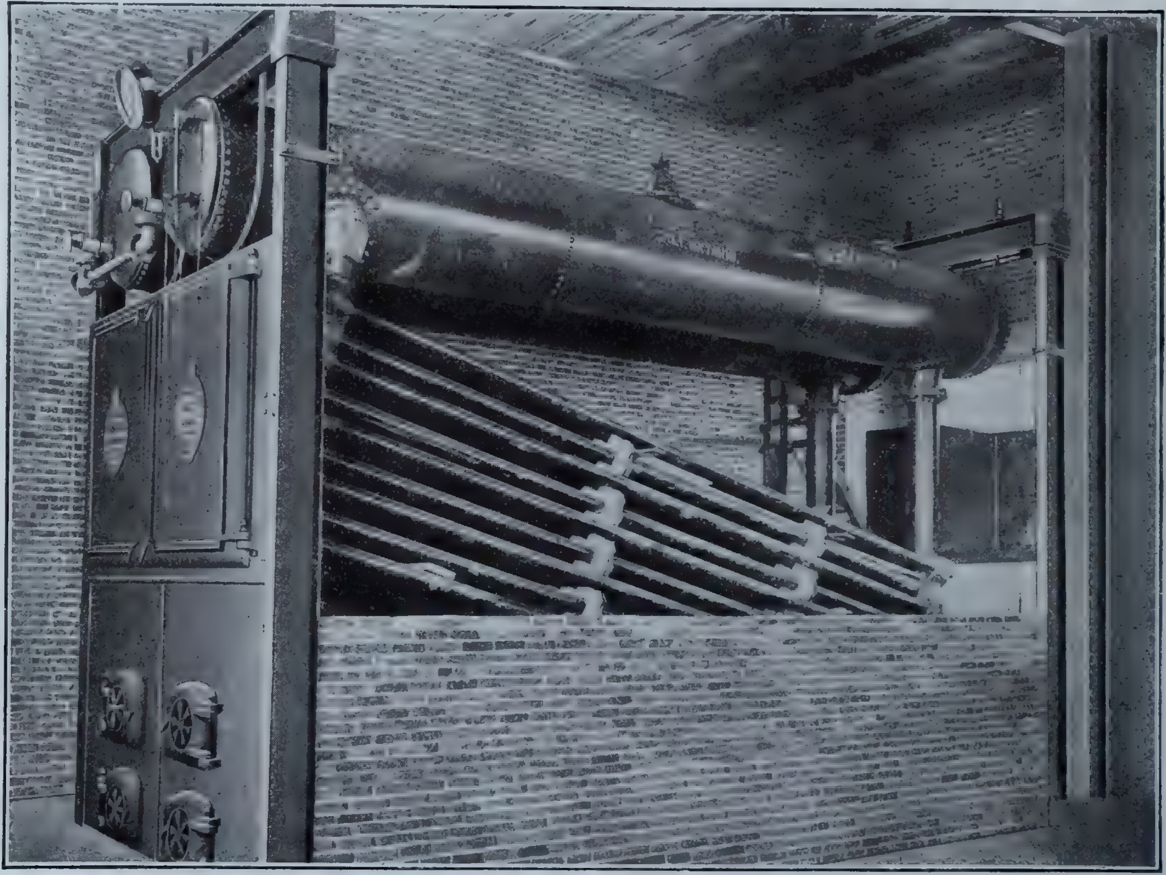

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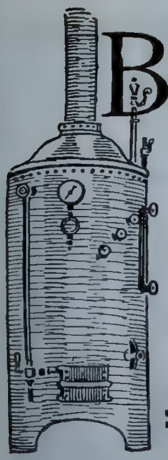
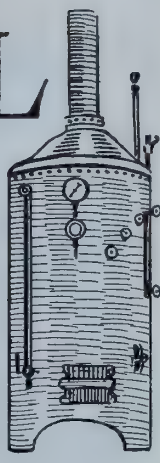


BOILER ROOM ANNUAL

THE POWER HOUSE

JUNE 1914



Power, Light and Heat in the C.P.R. Office Building, Toronto

Staff Article

The equipment installed in the new C.P.R. office building in Toronto, is an excellent example of an independent layout, and goes to show that given careful attention in individual feature planning, it is possible to secure power, light and heat more cheaply and with equal reliability of service than by outside purchase.

A HANDSOME office building, which until recently was the highest structure in Toronto, has been erected by the Canadian Pacific Railway Co. at the corner of King and Yonge Streets. The building contains several features of interest, the most important to readers of **The Power House** being the power plant, which is complete in every respect. The building was designed by Darling & Pearson, architects of Toronto, and comprises fifteen storeys, in addition to the basement and sub-basement. The ground and first floors are occupied by the C.P.R. themselves, and are used as business offices, while the fourteenth and fifteenth floors are occupied by their telegraph department. The remaining floors are let as business offices.

The power plant is located in the sub-basement, which is thirty feet below the street level. This floor is divided into three sections, comprising the boiler-room, engine-room, and pump-room respectively, while in the basement above are one set of ventilating fans, elevator pressure tanks, wash--rooms for the staff and the telegraph messenger department.

Boiler-Room.

An interesting feature of the plant is the well-equipped boiler-room. The installation comprises three water tube boilers, arranged in one double and one single battery, and supplied by the Babcock & Wilcox Co., through the Toronto office. Each boiler is rated at 160-h.p., and has 1,619 sq. ft. of heating surface. The tubes are 4 in. diameter by 18 ft. long, arranged in nine sections, eight high. The steam drums are 42 in. diameter by 24 ft. long, and the headers and cross boxes are of forged steel construction. The normal working pressure is 160 pounds. The boilers are equipped with **Dutch Oven** furnaces and **Murphy** mechanical stokers, the latter supplied by the Murphy Ironworks, Detroit, Mich.

A modern coal handling plant has been installed. The coal is dumped from the street down chutes into two large steel hoppers located on the west side of the boiler-room and under the sidewalk. The bottom of each hopper is fitted with a door to control the supply of coal to the conveyer running underneath. The conveyer carries the coal from the hopper to the top of the boiler-room, where it is fed into an **Avery** coal weigher, having a capacity of 1,000 pounds. The coal weigher is suspended from overhead tracks, and travels along over the furnaces to deposit the coal. The operations of the weigher are controlled from the floor. The conveyer system is driven by a 5-h.p. C.G.E. motor.

EXTERIOR VIEW OF BUILDING.

All the steam pipes are extra heavy, with **Crane** fittings. The boiler header is 8 in. diameter, branches 6 in., and main steam pipe 6 in. diameter. The steam pipes to the engines are 5 in., 4 in. and 3 in. diameter respectively. All the steam pipes are covered with 85 per cent. magnesia blocks, supplied by the Philip Carey Co., Toronto. In the breeching is a damper which is controlled by a **Spencer** damper regulator. A draft gauge, situated on a gauge board in the engine-room, will be described later.

Engine-Room.

The plant supplies light and power for the building entirely independent of outside supply. There are three direct-connected generator sets, the engines being supplied and installed by the International Engineering Works, Amherst, N.S., and the generators by the Canadian General Electric Co., Toronto. The engines are all of the same type; viz., high speed, horizontal, side crank, totally inclosed, and are fitted with forced lubrication and fly wheel governors. The three units consist of 100 k.w. running at 250 r.p.m, one 75 k.w. at 275 r.p.m., and one 50 k.w. at 280 r.p.m. The generators are all 3-wire, 250-volt d.c. machines.

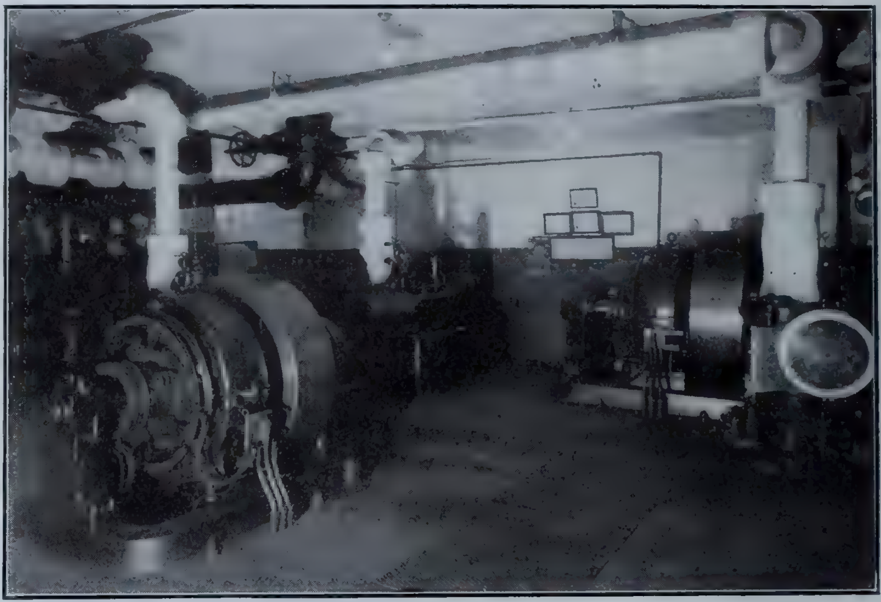
In the engine-room is a gauge board fitted with the following gauges, and supplied by the Jas. Morrison Brass Co., Toronto:—Boiler pressure; vacuum in heating system; compound gauge; altitude gauge, showing the height of water in feet in cold water service pipes; pressure in elevator piping system; pressure in the stand pipes; clock; recording gauge for steam pressure; recording gauge for heating system; recording gauge for vacuum system, and gauge for indicating draft in stack.

A 2 x ¾-in. Venturi meter is installed in the engine-room for measuring the amount of feed water passing to the boilers, while the drips from the various lines are returned to the feed water heater by "**Boylston**" return traps.

Switchboard

The switchboard is made of white marble, and was supplied by the Northern Electric and Mfg. Co., Montreal. There are six panels, consisting of three generator panels, one power panel, one lighting panel, and one low tension panel. Each generator panel has a Canadian Westinghouse circuit breaker, and at the back of the board are three Cutler-Hammer field regulating rheostats. The power and lighting panels are supplied with three "**Sangamo**" type watt-hour meters, and the low tension panels are equipped with one voltmeter and two ammeters of the Weston type, as are all the other similar instruments.

Two motor generator sets are installed in the engine-room for supplying current at 20 volts to a storage battery for the fire alarm and elevator signal system, etc. The sets were supplied by the Diehl Mfg. Co., Elizabethport, N.J. Current is supplied to the motors at 220 volts d.c., and for the electric lighting system at 110 volts d.c. Low tension distributing panels are installed on different floors for controlling the lighting and telegraph, telephone and clock system.


ENGINE ROOM, SHOWING ENGINES AND GENERATORS.

BABCOCK & WILCOX BOILERS WITH MURPHY STOKERS.

Pumping Installation.

The pumps for all services are installed in a section of the sub-basement adjoining the boiler-room. There are two **Deane** boiler feed pumps, 7½-5-6 in., horizontal duplex type, outside packed, double plunger pattern. The pumps are designed to operate against a head of 250 pounds, and are fitted with composition valve seats and disc valves. Two pumps, identical in every particular, care for the hot water service. In connection with this system is a hot water heater located near the pumps and heated by exhaust steam. The heater is fitted with a **Johnson** temperature control device, which automatically maintains the water at about 180 degrees, or as required.

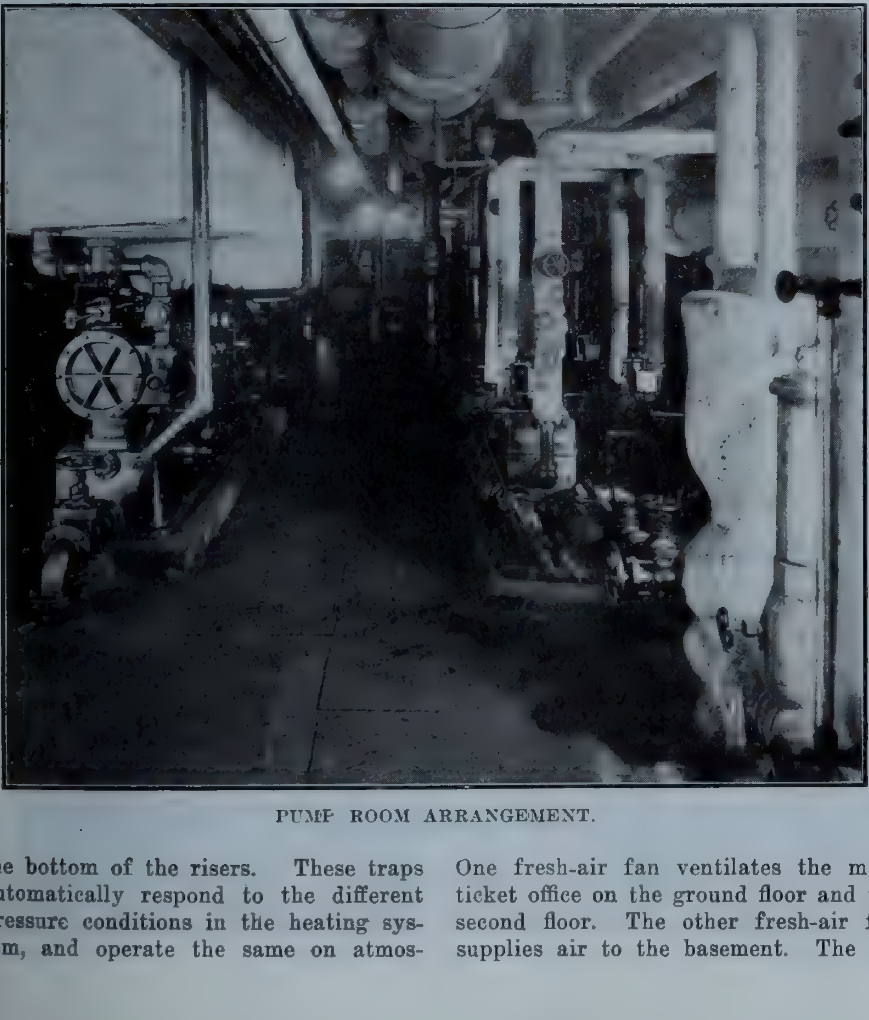
In connection with the exhaust steam heating system there are two "**Deane**" vacuum pumps, 8-12-12 in., double-acting, simplex, horizontal type, and equipped with governors. The receiver for the returns and the oil separator are situated near the pumps. The feed water heater is of the **Webster** type, and was supplied by Darling Bros., Montreal. All the pumps above mentioned were supplied by the Deane Steam Pump Co., Holyoke, Mass. There are two **Smart-Turner** centrifugal sump pumps, driven by 2-h.p. and 5-h.p. Canadian Westinghouse motors. The **Underwriter** fire pump, 14-7½-12 in., has a capacity of 500 gallons per minute at 70 r.p.m., and was supplied by Canadian Allis-Chalmers, Ltd., Toronto. A **Worthington** jack pump, 10-15-10 in., duplex type, is installed in connection with one of the elevators for use when lifting extra heavy freight. This pump gives a pressure of 600 pounds per sq. inch, which will lift a weight of 9 tons in the elevator.

Elevators.

There are four passenger elevators, three operating between the ground and the top floor, and one between the sub-basement and the top floor, the shaft of the latter being 230 ft. long. They are all hydraulic plunger type elevators, and were installed by the John McDougall Caledonian Ironworks Co., Montreal. Two **Worthington** steam pumps, located in the engine-room, supply the necessary power, 185 pounds being the working pressure. The pumps are horizontal tandem compound duplex type, 16-25-12-18 in., and pump water from a storage tank into two pressure tanks, located in the basement, each tank having a capacity of 5,000 gallons. Pressure is maintained in the pressure tanks by an air pump supplied by the American Air Pump Co. The elevators are controlled by "**Larsson**" valves of the latest pattern and equipped with four distinct safety devices, so that it is practically impossible for an accident to occur. Lamp signals are provided in the elevators, and operated by push buttons on each floor. The elevator enclosures were furnished by the Architectural Bronze and Ironworks of the Canadian Allis-Chalmers Co. Crane valves and fittings are used here throughout.

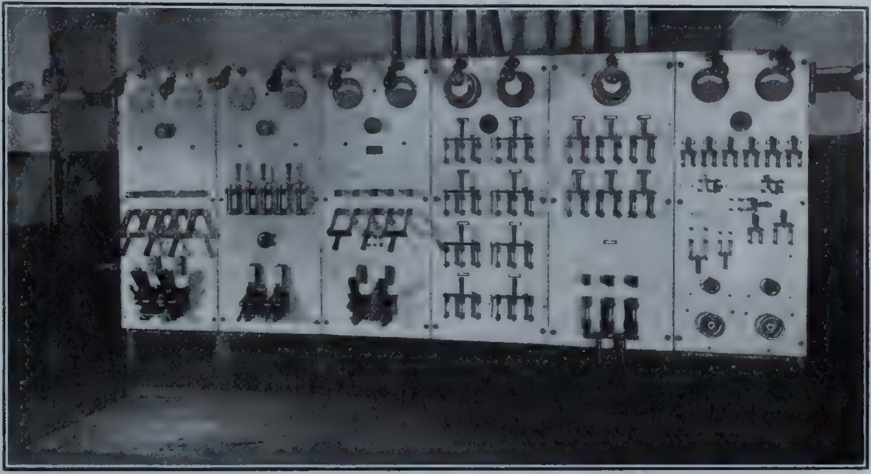
Heating and Ventilating.

The **Dunham** vacuum low pressure heating system is installed in the building. Exhaust steam from the generating units and pumps, etc., is circulated throughout at atmospheric pressure, while a vacuum varying from 4 to 12 in. is maintained in the return lines, depending upon the speed of the pump. Dunham thermastatic traps are fitted to all the radiators, steam mains, and at the bottom of the risers. These traps automatically respond to the different pressure conditions in the heating system, and operate the same on atmospheric pressure, or a few pounds pressure, or under vacuum conditions. The returns are collected in a receiver located near the vacuum pump, and are pumped to the feed water heater.



PUMP ROOM ARRANGEMENT.

Two separate fan systems are installed for ventilating certain sections of the building. One system comprises three motor-driven **Sheldon** fans, two being fresh-air fans, each having a capacity of 1,800 cub. ft. per minute, and driven by a 10-h.p. C.G.E. motor. The exhaust fan has a capacity of 20,000 cub. ft., and is driven by a 13-h.p. motor. One fresh-air fan ventilates the main ticket office on the ground floor and the second floor. The other fresh-air fan supplies air to the basement. The exhaust fan draws air from the main and the second floors.



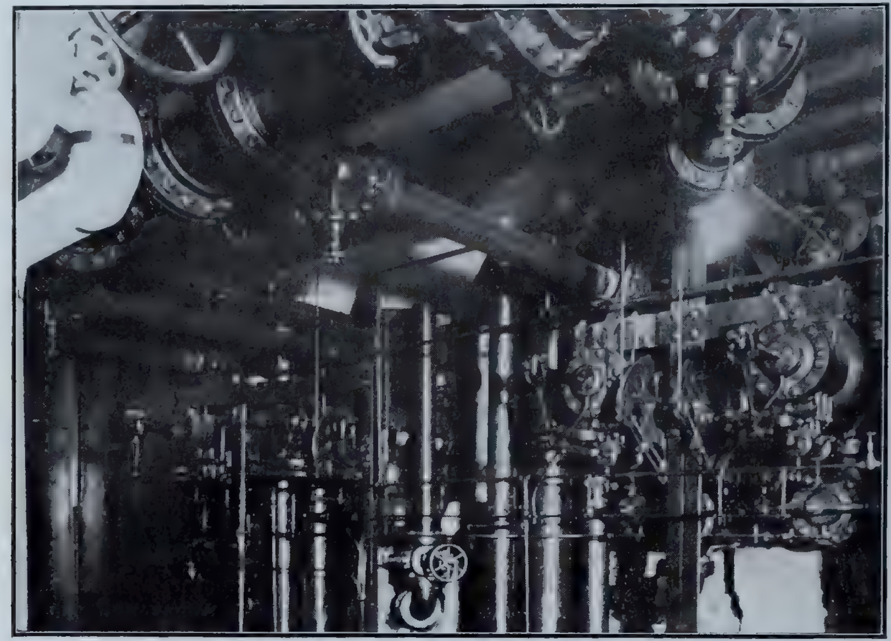
MAIN SWITCHBOARD.

The second fan system is located at the top of the building, and consists of two **Sheldon** exhaust fans, one having a capacity of 10,000 cub. ft. and the other 12,000 cub. ft. The former is driven by a 3-h.p. C.G.E. motor, and draws air from the telegraph rooms and the two top floors, while the latter fan draws air from all the lavatories throughout the building. This system also includes a fresh-air fan of **Sheldon** make, with a capacity of 15,000 cub. ft. and driven by a 7-h.p. C.G.E. motor. This fan supplies air to the two top floors.

In the discharge from each ventilating fan in basement there is installed a **Johnson** thermostat with relay valves, and **Johnson** diaphragm valves, controlling the steam supply to the individual sections of tempering coils, also by-pass damper beneath the tempering coils. These thermostats are set to any degree of temperature required in the sections ventilated by the fans. The tempering coils of fan serving the basement, although equipped with the control device, are not in service at normal times. Louvre dampers, approximately 20 sq. ft., are installed in the ducts leading to the fresh-air fans, and a damper is also installed in the duct leading to the exhaust fan. The louvre dampers are all automatically controlled by diaphragm motors.

The tempering coils of the fresh-air fan at the top of the building are equipped with a **Johnson** thermostat with relay and diaphragm valves. A by-pass damper is installed in the fresh-air intake of this fan, and is equipped with a diaphragm motor. Louvre dampers are installed in the discharge ducts from the two exhaust fans. These dampers are also equipped with diaphragm motors.

The louvre dampers are all controlled from pneumatic switches on a switchboard located in the engine-room, which is also equipped with a pressure gauge. The compressed air for operating the temperature control devices is supplied from a vertical Canadian Westinghouse steam-driven air pump located in the pump room. The automatic temperature control system was installed by the Johnson Temperature Regulating Co., Toronto.



HYDRAULIC ELEVATOR CONTROL VALVES.

There is steam service to the adjacent premises occupied by the Bowles Lunch Co. Exhaust steam is supplied for heating building, there being a total of 2,000 sq. ft. of heating surface, while live steam is supplied for such purposes as cooking, lavatories and barber shop. The amount of steam supplied in this way is measured by passing the returns through a "**Bundy**" return trap, which will hold a given amount of condensate. When full, the trap dumps and at the same time operates an indicator which shows the number of times the trap is emptied, thus making it an easy matter to calculate the amount of steam used. The returns from this source are delivered with the feed water to the boilers.

Fire Service.

Stand pipes are installed with hose connections on each floor. The **Underwriter** pump, already described, is connected to the stand pipes. In connection with the fire service is an alarm system. On each floor is a break-box connected with an annunciator and bell in the engine-room, the former indicating the floor from which the alarm has been sent in. This system was installed by the Neilson Electric Co., Philadelphia, Pa.

The Vacuum Cleaner System

A vacuum cleaner system has been installed throughout the building. In the pump-room is located the machine which was supplied by the American Rotary Valve Co., Chicago, Ill., through Geo. H. Tod, Toronto. It has a capacity of four sweepers and 285 cub. ft. of air per minute, and is capable of maintaining a vacuum of 12 in. It is of the reciprocating type, and is operated by a 15-h.p. **Jenny** motor. The machine can be reversed to pump air through the system to clean inaccessible places, such as behind radiators, and is in addition equipped with a mechanical self-cleaner.

Pneumatic Messenger Service.

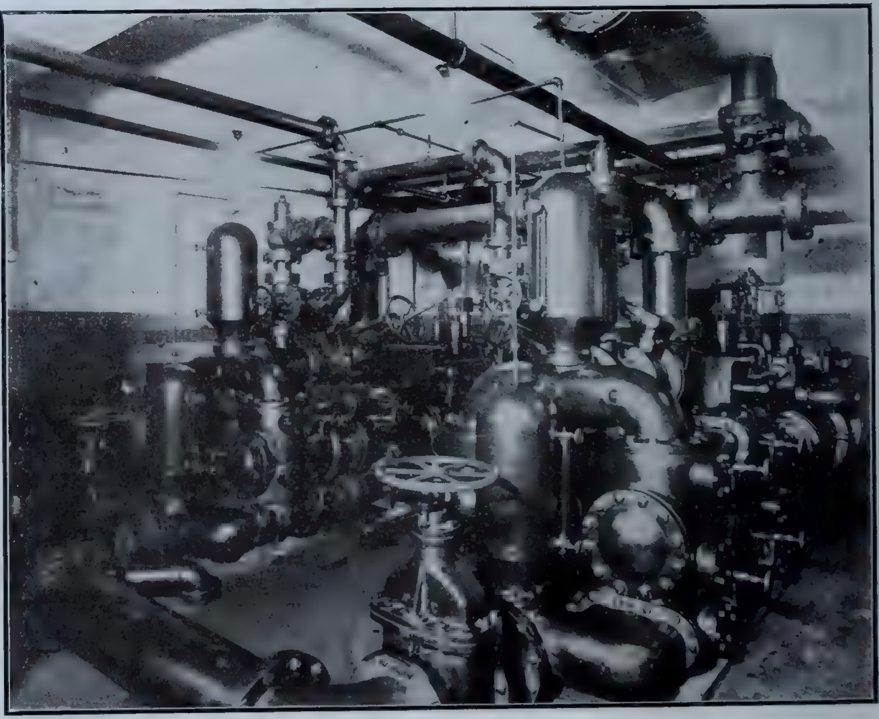
Between the telegraph department on the top of the building and the messenger department in the basement are a number of pneumatic tubes which are supplied with air from a blower located in the pump-room. The blower is of the positive rotary type driven by a 3-h.p. Sprague Electric Co. motor, and supplied by the Connersville Blower Co., Connersville, Ind. The blower is capable of delivering 3.3 cub. ft. of air per revolution and runs at 300 r.p.m.

Miscellaneous Features.

There are thirty-two watchmen's stations, each being connected electrically to an indicator in the engine-room, which is equipped with a recording chart. This system was installed by the Holtzer-Cabot Electric Co., Boston, Mass.

The electric clock system was installed by the Self-Winding Clock Co., New York. There are eleven clocks controlled by a master clock placed on the telegraph floor, and synchronized every hour. The clocks are self-winding and self-adjusting, these operations being performed electrically and controlled from a low tension circuit.

The consulting engineers were James McAlear & Co., of Chicago, the work being supervised by J. Melvin Thomas, of Toronto. The plumbing and heating contract was carried out by W. J. McGuire & Co., Toronto. The counter railings in the ticket office and the fire escape were supplied and installed by the Architectural Bronze and Ironworks of Canadian Allis-Chalmers, Ltd., Toronto, while the mail chutes were supplied by the Canadian Cutler Mail Chute Co., Montreal. The G. A. Fuller Co., Toronto, were the general contractors.



WORTHINGTON ELEVATOR PUMPS.

Boiler Inspection Service, Saskatchewan Province

By R. M. Blackburn *

In view of the diversity of regulations in the various provinces of the Dominion relative to steam boiler inspection and engineers' licenses, this article has a direct personal interest for readers of our journal. It goes to show that, in the realm of stationary steam engineering, Canada's Western provinces are not only away ahead of those in the East in the matter of boiler inspection regulations, but that higher standard service possibilities are brought within reach of the operator.

THE subject of boiler inspection occupies a large place among engineers both in Canada and the United States. Several provinces of the former and states of the latter have adopted compulsory inspection, while others have the matter under consideration. Although it is not intended in this article to present arguments in favor of compulsory boiler inspection, which at the present stage should scarcely be necessary, a brief account of the boiler inspection service in Saskatchewan will no doubt be of interest. The first act providing for the compulsory inspection of steam boilers in the Province of Saskatchewan, was passed by the Legislative Assembly in 1898, and a new act was passed in 1906, which subject to later amendments, is still in force. The acts have operated very successfully, and there have been very few serious accidents since the inspection service was inaugurated.

Efficiency of Boiler Inspection.

The efficiency of boiler inspection depends almost entirely on the capabilities of the individual inspectors, and it is of the highest importance that men appointed for this service should thoroughly understand their work and be able to command the respect of engineers and others with whom they come into contact. The Saskatchewan Act provides that no person shall be appointed an inspector unless he has had at least four years' experience as a practical machinist or boiler maker, is the holder of a first class engineer's certificate, and has also passed a special examination on the construction, maintenance, etc., of steam boilers. It may be mentioned here that a high standard of qualification is required to obtain a first class engineer's certificate in Saskatchewan. Candidates for this class of certificate are required to possess a thorough knowledge, both theoretical and practical, of the operation of steam boilers and engines and in consequence, very few of these certificates have been granted.

Province Imports Boilers.

Few boilers are built in Saskatchewan, nearly all of them being manufactured elsewhere, and shipped into the province. During the last few years an average of considerably over 500 new boilers per annum have been brought in, about 40 per cent. being manufactured in Eastern Canada, the remainder coming principally from the United States.

Owing to the very diverse standards of construction adopted by the several manufacturers it was very soon realized that an adequate system of boiler inspection should commence with the supervision of the design and construction of boilers shipped into the province and that a minimum permissible standard of construction and workmanship should be adopted. After some correspondence with neighboring provinces a conference was held at Regina in December, 1909, which was attended by representatives of the Governments of British Columbia, Alberta, Saskatchewan, Manitoba and Ontario. At this conference regulations were drawn up governing the construction of steam boilers and providing for the examinations and registration of designs. These regulations were at once adopted by the Provinces of Alberta and Saskatchewan and have more recently been adopted by the Province of Ontario. Regulations governing the construction of steam boilers, have been in force in British Columbia since 1902. These regulations are somewhat similar, but not identical, with the regulations drawn up at the Regina conference.

Registration of Manufacturers' Designs.

An important feature of the new regulations was the compulsory registration of manufacturers' designs. This was at first somewhat resented by a few manufacturers. It has, however, been found to operate well in practice and to have advantages over the methods followed by some authorities. In the first place, the rule brings manufacturers into closer touch with the boiler inspection department on questions of design, and avoids any misunderstanding which, in view of the many different types of boilers in use, is always possible even with the most carefully-worded regulations.

When a design has been approved and registered the manufacturer can build any number of boilers to that design, and, provided the workmanship is up to the standard, he can be sure that the boiler will meet the requirements of the department, and that the boiler will be allowed to carry the registered steam pressure. He is thus in a position to guarantee to the purchaser that his boiler will pass inspection for a certain pressure per square inch. Any novelties in construction or departures from standard practice can also be submitted to the department and discussed before being adopted.

In Massachusetts and other States the boiler inspection department does not make a practice of approving detail drawings of boilers, and the interpretation of the rules is left to the manufacturer who cannot be sure, especially in the case of a new design of boiler, that the boiler will pass inspection until it is actually built. It is obvious that an arrangement of this kind would not be satisfactory where boilers for use in the province are manufactured over so wide an area, and are frequently shipped long distances to the purchaser.

Inspection Staff.

Up to the present about 450 designs of boilers and over 300 designs of steam fittings have been approved by the department. A fee of $10 is made for the registration of each design of steam boilers, and a fee of $3 for the registration of each design of fittings, etc.

There are at present thirteen district boiler inspectors, together with a chief inspector, whose headquarters is at Regina.

Each district inspector is allotted a separate district, and is required by the Steam Boilers Act to inspect each boiler in his district at least once in each year. In the more sparsely-settled districts it has not been found practicable to entirely cover the entire district each year, but as far as possible this is done. Each boiler is numbered and a record giving full particulars covering its condition at the time of inspection and particulars of repairs ordered (if any) is transmitted by the inspector to the head office and filed. A history is thus kept of each boiler in the province. The number of boiler inspections made during last year was 2,818, and repairs were ordered on 536 boilers. A brief summary of the defects noted and repairs ordered during the past year will be of interest.

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*Chief Inspector of Steam Boilers, Regina, Sask.

Defects Noted and Repairs Ordered.

Bulged and warped crown sheet to be set back or straightened, 60.

New stays ordered in firebox sides or crown sheets, 41.

New head-to-head stays required, 16.

Belly stays to be put in flue sheets, 19.

Leakages at seam to be caulked, 11.

Bulged side sheets to be set back or stayed, 5.

Leaky flues, 20.

New flues ordered to be put in, 20.

Boilers to be entirely re-flued, 23.

Leakages at stays to be caulked, 10.

Flue sheets bagged, 13.

New mud ring required, 1.

Bags in shells in return tubular boilers, 9.

New courses ordered, 2.

Girth seams, new rivets required, 4.

Plates to be patched, 7.

Leakage at bracket bolts of traction boilers, 15.

Repairs to brickwork setting and suspension, 10.

New steam gauges ordered, 58.

New safety valves ordered, 55.

New blow-off valves ordered, 43.

Fusible plugs to be renewed, 44.

Injectors, check valves, feed pipes, etc., to be renewed or repaired, 46.

Water glass mountings, try cocks, etc., to be renewed, 24.

Syphons to be provided for steam gauges, 9.

Alterations required to water column or connections, 8.

New stop valves required, 10.

Blow-off pipes to be altered, 8.

Defective feed pumps, 5.

Provide additional means of feeding boilers, 8.

Boilers ordered to be cleaned or scaled before further use, 5.

Boilers condemned as unfit for further use, 3.

Sundry repairs, 66.

Observations on Boiler Defects.

In the above list the number of warped and bulged crown sheets is noticeable. This is due in great measure to the bad feed water used in many parts of the province, especially for agricultural engines. Much of the feed water is alkaline, and contains a great deal of mud and deposit, which, settling in the crown sheet when the boiler is at rest, causes overheating when the boiler is fired up again. That the warping of the crown sheet is not caused to any great extent by neglect in washing out the boiler is shown by the comparatively few cases of bulging of the sides of the firebox near the bottom of the water leg. The regulations now require all new traction boilers to have arched crown sheets. This to a considerable extent prevents the mud lying on these, but a large number of the older traction boilers in the province have flat crowns, and the trouble usually occurs with them. The alkaline water is also severe on flues and stays, causing leakages at the joints.

Steam gauges are frequently damaged by frost, through not being properly drained when not in use. The department requires all traction boilers to be provided with double tube gauges. These are more readily drained, and the pointer is also more steady when the tractor is in motion than in the case of single tube gauges. The regulations also require that each boiler shall have two separate means of feeding water.

Want of proper care when traction boilers are out of use frequently causes boilers to deteriorate much more rapidly than they should. After the threshing season, the boiler is generally left exposed to the weather; ashes and soot are left lying in the fire-box and smoke-box, and the engine is sometimes left just as it was when the threshing was finished until next season. The ashes and soot attract moisture, rain finds its way down the smoke stack and keeps the soot and ashes in the smoke-box wet. The consequence is rapid corrosion of the front tube plate, fire-box and smoke-box.

The importance of removing all ashes and soot and thoroughly cleaning out the boiler at the end of the season is fairly well understood by most engineers, but is not sufficiently appreciated in some cases by the owners of traction engines, who are sometimes unwilling to retain the services of the engineer a moment longer than they can help after threshing is over.

There are over 6,000 boilers in the province; these boilers are at present being re-numbered, and full particulars of each are being taken and filed at the head office. This work is not yet completed, although, up to the present, records of over 4,500 boilers have been taken and placed on file for ready reference.

Engineers' Licenses.

All engineers in the province are required to hold licenses from the steam boilers branch of the Department of Public Works. These licenses are divided into five grades, of which the first, second and third-class certificates, together with traction engineers' final certificates, are good for life. The examination for these certificates is a written one, and the standard of qualification is fairly high, especially for a first-class certificate. Provisional certificates authorizing the holder to operate boilers not exceeding 40-h.p. for a period of one year from date of issue are granted to applicants having the necessary experience upon passing an oral examination before a boiler inspector. These certificates can be renewed on expiration, or the holder may, if he desires, take a written examination for a final certificate.

Examinations for all grades of certificates except for first-class certificates are held during the winter months at all principal railway points on advertised dates, and examinations can also be taken on the first Monday in each month at each district inspector's headquarters. Examinations for first-class engineers' certificates can only be taken at Regina.

The number of certificates issued during last year was as follows:

Provisional certificates...........	3,858
Third-class engineers' certificates..	517
Second-class " " ..	68
First-class " " ..	19

The traction engineer's final certificate is a new grade of certificate authorized by the last session of the Legislature, and is intended more especially to meet the requirements of threshermen and operators of agricultural engines.

Any certificates may be suspended or canceled for gross carelessness, inefficiency, intemperance while in charge of a steam boiler or a serious breach of the Steam Boilers Act. Few cases, however, occur of this kind, as considerable care is taken in granting permanent certificates.

By a recent amendment the Steam Boilers Act has been extended to cover low-pressure heating boilers in apartment houses, office blocks, hotels and public buildings, and when these boilers exceed 40-h.p., the operator is now required to hold a fireman's certificate.

The efficiency of the boiler inspection is shown by the few accidents which occur. With the exception of warped and bulged crown sheets and shells, none of which were very serious, no accidents occurred during the past year. The only calamity reported was an accident caused by a man stepping through a hole in a sawmill floor near the engine fly wheel, where a plank had been removed a few days before in order to take off the wheel and had not been replaced. The unfortunate man fell on the belt and was taken around the wheel and instantly killed.

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Finding Compressed Air Leaks. — When steam escapes you can generally see or hear it, and when there is a leak in an ammonia pipe line that also is immediately evident, but a leak in a compressor air line entailing an appreciable loss may go for a long time unnoticed; not that it is more difficult to make the air line tight, and to keep it tight, than the others. An Illinois manufacturer at regular intervals puts essence of peppermint into the air system, and then has all the pipes inspected for leaks. If the smallest amount of air escapes anywhere it is revealed by the odor.—Ex.

PROBLEM OF COAL STORAGE.

THE problem of coal storage is an impotant one to every power house engineer. In order to safeguard the continuity of power supply when there is a shortage of coal due to strikes or other causes, a reserve supply of fuel must be kept. It is, however, by no means an easy matter to store coal in a satisfactoy manner, because even if means are taken to avoid the obvious forms of trouble such as spontaneous combustion, there is always—when coal is exposed to air — a slow oxidation which tends to deteriorate the calorific value of the fuel. A good deal of attention has been paid to this matter within recent times, and one or two notes on the subject may be of interest.

U.S. Bureau of Mines Investigation.

The United States Bureau of Mines recently investigated the deterioration of various kinds of coal under storage, and it was found that, while several coals evolved methane in large volumes, especially in the early period after mining the coal, the gas evolved in one year from this cause means a maximum loss in calorific value of 0.16 per cent., this loss covering a period of one year from the time the coal was mined. The Navy Department tests show a loss of less than 1 per cent. in a year on New River coal weathering in the open; and Pocahontas coal in a 120-ton pile on the Isthmus of Panama lost less than 0.4 per cent. during one year's outdoor weathering. Pittsburgh gas coal suffered no loss whatever during six months' outdoor weathering. Wyoming coal, however, lost 5.3 per cent. during two years and nine months, 3.5 per cent. of which was lost in the first three months. For a distance of from 12 to 18 in. from the surface there was bad slackening and crumbling of the lumps. Illinois coal as tested by Prof. Parr, of the University of Illinois, lost 1 to 3 per cent. in a year with slackening and crumbling.

The average value therefore appears to be a loss of 1 to 3 per cent. of heating value in one year, a large percentage of this loss occurring within from three to six months after the coal has been placed in storage. Mr. Perry Barker, in a paper before the American Society of Mechanical Engineers, says that some results of tests on German gas coals have been given which state that these fuels have lost an average of 1.7 per cent. of heating value per week, but on the basis of the American tests it is apparent that the loss in heating value is not the most serious consideration in the question of coal storage.

Spontaneous Combustion Danger.

The danger which is to be most carefully avoided in connection with coal storage is the more rapid form of oxidation known as spontaneous combustion. Mr. Barker names the causes of spontaneous combustion as the escape of inflammable gases from fresh coal surfaces, the absorption of oxygen from the air with the production of heating, the presence of fine coal which brings large surfaces into contact with the air and so accelerates the oxidation of the whole mass, the presence of an excessive amount of moisture (especially if the coal under storage becomes alternately wet and dry), and in some cases the presence of external causes of heating even if these are very moderate in amount.

As regards the escape of gases, he states that the results of experiments in freshly mined coal show that the loss of gases is about equal to the volume of coal, and the heating value of such gases amounts to 0.1 or 0.2 of the heating value of the coal. The point about this is not the actual calorific value which is lost, but the danger of explosion attending on the escape of such inflammable gases; while the evolution of heat accompanying oxidation is one of the great causes of danger of spontaneous combustion in coal piles. Heat from steam pipes, boiler and walls also tend to the ignition of the mass.

Avoiding Spontaneous Combustion.

Various authorities have advocated means of avoiding spontaneous combustion. Summarizing various recommendations, it may be said that safety is promoted by observing the following precautions. Combustible gases (that is to say, gases which are likely to separate out freely) should be eliminated before storage; in other words, freshly mined coal—particularly if it is gassy—is not safe for storage, and about six weeks' seasoning should be allowed after mining before storage. The storage piles should not be over 10 to 12 ft. deep, and should be so disposed that any point in the interior will not be over 10 feet from the air-cooled surface. If possible, lump coal only should be stored, the removal of fine coal being effected by screening. Dust should be kept out as much as possible.

The method of placing the coal in storage should be such that it is not broken up during handling. If a mixture of lump and fine coal is stored, the various sizes should be well mixed together and evenly distributed so that the formation of air passages is avoided. These very often occur if the storage pile is so formed that large lumps roll down from the peak and form air passages at the bottom. It is not wise to attempt ventilation by pipes; and care should be taken to see that there is no infiltration of air through brickwork, timber or porous foundations, such as coarse cinder. It is a useful precaution to rehandle and screen the coal after every two months.

There is great danger of gas explosion as well as spontaneous combustion if powdered coal is stored. Fine coal, if required, should be pulverized immediately before use in the furnace and at the rate required at the time. Weather conditions should be guarded gainst where the coal is subject to wetting and drying. For example, a bad storage would be one in which the rain can fall on the pile and be subsequently dried off by the sun or the warmth from steam pipes. External sources of heat, even moderate in degree, should be carefully kept away from the coal pile.

Submerged Storage.

Heating extending to spontaneous combustion, it is maintained, can be eliminated by submerged storage. It is stated that in cases where coal has been stored under water in concrete tanks of considerable capacity, the practically negligible loss in calorific value thus obtained considerably more than counterbalances the increased amount of moisture in the coal as fired to the boiler furnace, and such submerged storage renders spontaneous combustion impossible. Moreover, the result is obtained regardless of the size of the coal stored. A large Chicago manufacturing firm employing this method has found that with Illinois coal ranging from dust up to about 1¼-inch lumps, the method works satisfactorily. The fuel, after being loaded out for storage, is allowed to drain for a few hours before passing to the chain-grate stokers with which the boiler furnaces are fed.

It is stated that the cost of handling coal in a scheme of this sort should not be more, and may be distinctly less, than when it is piled upon the ground in the open air. Mr. Barker refers to a method which has been recently adopted in order to reduce the amount of contained moisture in coal storage in permanent contact with water. This is by only partially submerging the coal; and it is stated that the exposed portion of the coal pile absorbs a sufficiently high percentage of moisture through capillary action to prevent any danger of serious oxidation.

The above notes give only in brief outline the general features of a problem which is of very great interest to all power-house engineers, but the suggestions may form a sufficient starting point for investigations to be carried out with the object of reducing the large margin of loss and danger which at the present time exists in many coal storage schemes.—Engineering Review.

Results of Neglected Leakage from Boiler Joints, Et

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

FURTHER and diversified examples of the effects produced on steam boiler vitals through leakage and consequent corrosion are here featured, and, as pointed out in the introductory note of a similar article in our May issue, close attention to the cure of leaks, however caused and seemingly unimportant, is incumbent on all interested or engaged in steam boiler safety operation.

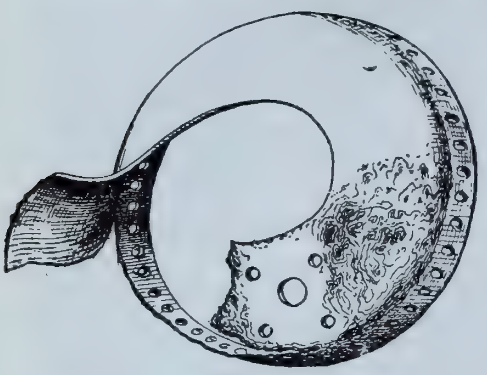

FIG. 12.

Corrosion Round Joints and Parts Not Covered with Brickwork.

Fig. 12 shows the front end plate of a boiler superheater. Owing to leakage at the joint of the manhole, severe corrosion of the lower part of this end plate has occurred. This corrosion is most extensive at the lower curvature towards the left at the part where the brickwork tends to hold the moisture. The thickness originally of 11.5 m.m. is, over a space of 400 m.m., reduced to nothing.

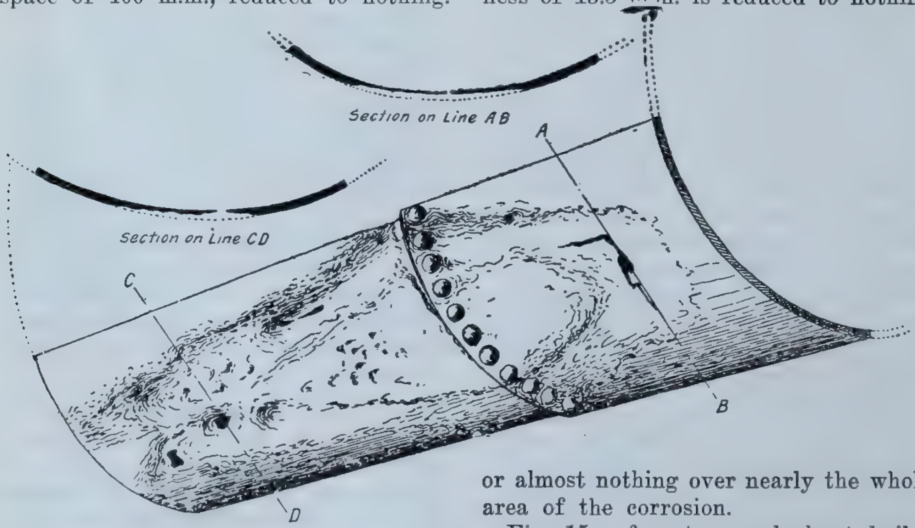

FIG. 14.

The end plate has given way along the curvature, and this first rupture has extended as far as the manhole across a very severely corroded part in which the thickness varied from nothing to 11.5 m.m.

Corrosion at the Point of Contact with Brickwork.

Fig. 13 shows the base of the neck connecting the steam receiver of a multitubular boiler with the nest of tubes. —This part is covered with brickwork. Persistent leakages at the expanded part of the tubes have caused severe corrosion. The original thickness was from 6 to 7 m.m. It has been reduced to nothing on the whole circumference and for a height of 20 to 70 m.m.

Fig. 14 represents the bottom of a mud-drum of a multitubular boiler. The lower part was in contact with brickwork, dust, etc. Owing to a leak at the circular seam severe corrosion has occurred over a space varying from 300 to 600 m.m. This corrosion has only attacked the part where contact with external substances has retained moisture. It is almost uniform. The original thickness of 13.5 m.m. is reduced to nothing or almost nothing over nearly the whole area of the corrosion.

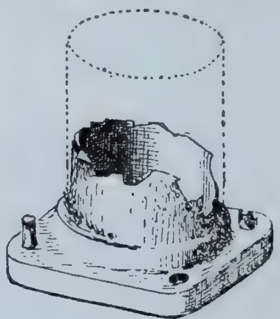

FIG. 13.

Fig. 15 refers to an elephant boiler with two drums. Corrosion arose at the bottom of the back end shell ring of one of the drums owing to leakage at the manhole joint. This part being covered by brickwork was always in a damp condition. The corrosion extended over a length of 350 m.m., with a maximum breadth of 120 m.m. The thickness is reduced to nothing at the lap, the breadth of which is reduced. The seam has been least attacked, there being a remaining thickness of about 5 m.m. In front of this the corrosion increases, and at one point a hole has been formed, The rivets are headless. The original thickness of the plate was 9.5 m.m.

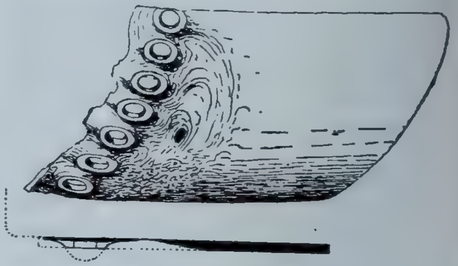

FIG. 15.

Corrosion of Parts Fired by Gases.

Fig. 16 shows a tube in the lower row of a multitubular boiler set over a puddling furnace. The tubes had an original thickness of 4 m.m. Corrosion arising from the sulphuric acid contained in the gases has affected them in a manner almost uniform. At the place of fracture, the tube which failed has a thickness varying from 0 to 2 m.m.

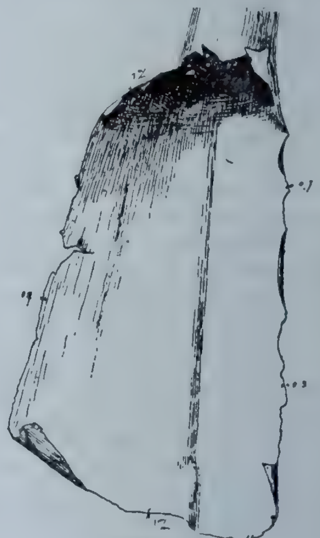

FIG. 16.

Fig. 17 represents a piece of a flue tube of an elephant boiler with two drums and flue tubes, fired with coke dust. The plate indicates an appearance of general wear and tear which have reduced its thickness from 3 to 4 m.m. At the center of the piece there is a blister, of which the exterior side has not been attacked so severely by the corrosion. It is probable that by reason of the non-adherence of the coke dust, the exterior side has generally been in a hotter condition and was able in consequence to better resist the corrosion.

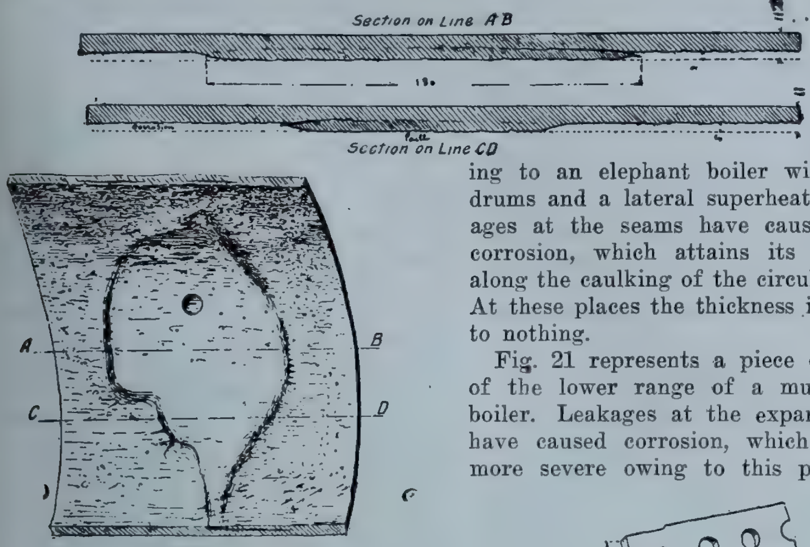

FIG. 17.

Corrosion of Parts in Contact with the Fire.

Fig. 18 refers to a boiler with two superheaters set to work in 1891. A piece of the superheater plate (original thickness 9 m.m.) is the part affected. Leakages at the overlap of the circular seam have caused severe corrosion, which extends over a space of 450 m.m. in length with a breadth at the overlapping part of 300 m.m. A little below this, the thickness is reduced to nothing at one point. The corrosion extends almost into the seam itself, where it is, however, of little importance. The heads of the rivets are slightly affected. The corrosion developed in four years.

Fig. 19 belongs to a boiler with superheater, the illustration showing a piece of the superheater plate (original thickness 7.5 m.m.). Leakages at the overlap of the plates have produced a corroded groove, which extends along the circular seam. Its breadth is 70 m.m. The corrosion is greatest near the overlap, where at one point the plate is holed. Commencing from this point it decreases rapidly.

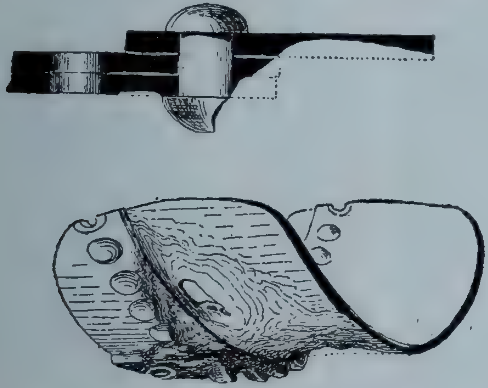

FIG. 18.

Fig. 20 shows a piece of the high part of one of the circular seams of the superheater, thickness 11 m.m., belonging to an elephant boiler with three drums and a lateral superheater. Leakages at the seams have caused severe corrosion, which attains its maximum along the caulking of the circular seams. At these places the thickness is reduced to nothing.

Fig. 21 represents a piece of a tube of the lower range of a multitubular boiler. Leakages at the expanded part have caused corrosion, which was the more severe owing to this part being generally covered with soot. A piece of the tube has been displaced by the pressure.

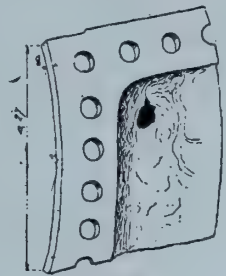

FIG. 19.

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HARD WATER FOR BOILER FEED.

PROBABLY the greatest loss caused by the average hard water is due to the formation of scale on the heating surfaces of the boiler. Scale, being a nonconductor of heat, tends to insulate the heating surfaces of the boiler from the water within, so that to evaporate the same amount of water a greater amount of fuel must be used when the surfaces are scaled than when they are clean. As the amount of this loss depends directly upon the thickness and composition of the scale, the amount of heating surface covered, the type of boiler and the operating conditions, it is impossible to state definitely what the loss would be in any individual case.

Fuel Consumption and Scale.

There have been a great many purely scientific experiments made, the results of which demonstrate thoroughly that an excess amount of fuel is necessary to produce results on scaled boilers. In one case of a locomotive where the heating surfaces were covered with scale ranging from 1-32 to 3-64 in. in thickness, it was found that the locomotive would evaporate 12.6 per cent. more water after cleaning than when the tubes were scaled, the net increase in fuel consumption in this boiler being 9.55 per cent. Another series of tests on scaled boiler tubes taken from different boilers showed that the amount of fuel required to drive the same amount of heat through the tubes varied from 5.96 to 15.75 per cent., depending upon the thickness of scale. The average fuel loss in boilers using hard water is anywhere from 10 to 50 per cent., and this occurs not only in the boilers, but in enclosed heaters and economizers as well. In addition to the cost of this waste fuel, the cost of handling the coal and the ashes resulting from it must also be considered.

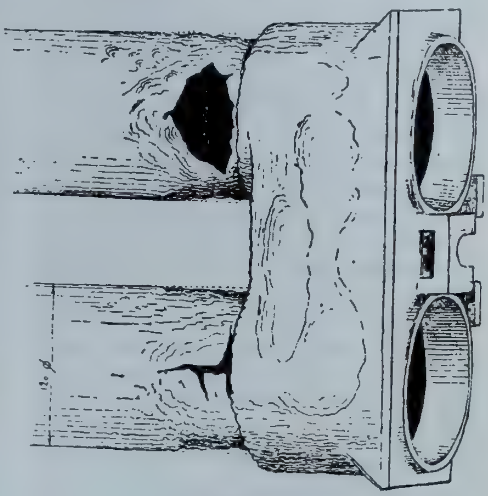

FIG. 21.

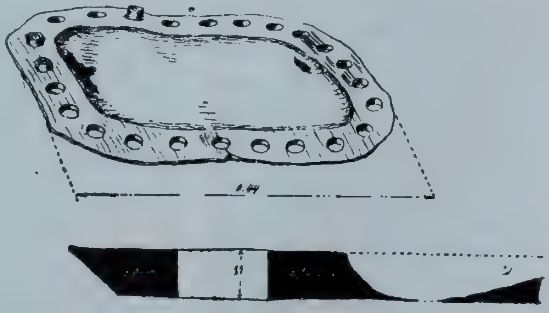

FIG. 20.

Decrease in Efficiency Caused by Scale.

In a number of cases the loss of fuel is not as important as the loss of efficiency. The insulating properties of the scale lower the efficiency of the boilers, at it is impossible to force as much heat through a scaled tube or sheet as through a clean one. This lowering of efficiency frequently reduces the actual capacity below the demand, so that additional equipment is required to carry the load. If this has to be installed there is another charge which must be placed directly against the effect of hard water.

While stokers or other apparatus are sometimes installed to overcome this loss in efficiency, at the same time they have a tendency to decrease the percentage of efficiency, as the additional evaporation causes more scale to be deposited with a further reduction in the actual efficiency. The presence of scale in water tube boilers decreases the available heating surface by building up inside the tube and decreasing the area. The general practice with scaled boilers is to put them out of service and remove the scale by mechanical cleaners, and the cost of this work, together with the investment on the tools used, must also be taken into consideration.

Foaming and priming of boilers is often caused by the presence of certain scale-forming ingredients in combination with organic or suspended matter. A foaming boiler by mechanically carrying water from the boiler greatly decreases the steaming capacity, and, in addition, there is the danger of getting water into the engine cylinders, which tends to reduce the effect of lubrication and cut both the cylinder and the pistons.

Fuel Required to Recommission a Boiler.

After a boiler is cleaned, the amount of fuel required to place it in service is directly chargeable against scale, as the boiler was in operating condition at service pressure when it was taken off for cleaning. The amount of coal required to accomplish this is approximately 2,000 lb. per 100 boiler h.p., and its cost can be estimated directly by the number of B.t.u. which are required to raise the temperature of the water in the boiler from 200 deg. F. to 338 deg., which corresponds to a guage pressure of 100 lb. As a 100 h.p. boiler holds approximately 190 cubic feet of water, it will require 12,065,000 B.t.u. to put the boiler into service at 100 lb. pressure, which will theoretically require 1,150 lb. of coal, containing 10,500 B.t.u. per lb., or 1,533 lb. if 75 per cent. boiler efficiency is maintained. As a matter of fact, the amount of coal required will be approximately 2,000 lb. to take care of the amount of heat absorbed by the furnace and the masonry work.

Boiler Accidents a Result of Scale.

Scale and corrosion are responsible for a large number of boiler repairs, many of which are caused by burnt or ruptured sheets or tubes that have become overheated through the insulating effect of the scale. Out of a total of 136,682 boilers inspected in 1909 by the Hartford Steam Boiler Inspection and Insurance Compaany, 8,165 were reported as defective through burnt or fractured plates, 18,607 defective through leaky seams and tubes, and 17,274 defective through internal corrosion. In addition, 106,141 boilers were reported as defective and 6,755 as dangerous, through reasons directly traceable to the presence of scale or corrosion.—From a paper by K. W. Bartlett, inventor of the Bartlett-Graver water softener, East Chicago, Ind.

VENTILATING THE COAL PILE.

A simple device to prevent spontaneous combustion where bituminous coal is stored in large piles was adopted recently by the Swineheart Tire & Rubber Co., Akron, Ohio. At 12 feet intervals throughout an 800 ton pile of coal vertical vent ducts were placed. These ducts, consisting of square boxes made of 10 in. boards in which 1 in. holes were bored on 6 in. centers, were placed upright on the site used for coal storage, and the fuel was dumped about them. The function of the pipes is to carry off the heat and gases formed in the interior of the stored coal, thus preventing undue rise in temperature and formation of gas pockets.

H. L. Houk, purchasing agent for the company, says that their experience with run-of-mine coal has shown that spontaneous combustion need not be feared with vent pipes placed vertically on 12 feet centers. Where slack coal is to be stored, he believes that horizontal ducts leading to the vertical risers should be installed.

CAST IRON IN BOILER VALVES.

From the Board of Trade report of the explosion from a boiler stop valve chest at Pinkston Tramway Power Station, Glasgow, on November 10th, 1913, it appears the explosion was due to the long-continued action of superheated steam on the cast iron, causing disintegration and deterioration of the material of the valve chest, and it is added that a number of manufacturers have entirely ceased to use cast iron when superheat is specified, not only in land installations, but also in connection with marine work, as they do not consider it reliable. Power stations in Glasgow are now to be entirely equipped with steel mountings on boilers and steam pipes. It would seem, indeed, if superheating becomes common, or much higher boiler pressures are to be used in the future, that cast iron must be barred for boiler stop-valves and steam pipe ranges, either as junction pieces or expansion glands.

CONCRETE SMOKESTACKS.

Numerous practical trials, says a writer in The Power User, have shown that concrete and reinforced concrete are quite suitable for the construction of smokestacks.

The design of concrete stacks as regards internal diameter and height proceeds as for masonry stacks. To withstand gas temperatures exceeding 570 degs. F. a refractory lining should be fitted to the parts concerned. Iron and concrete have practically the same coefficient of thermal expansion, but very different heat conductivities, and unless the iron be deeply embedded, it is likely to become hotter or cooler than the concrete, and hence to break its bond with the latter.

As regards air leakage and thermal losses, concrete is at least equal to masonry. Boiler gases do not attack concrete appreciably, but in chemical works it is necessary to distinguish between acid fumes forming soluble or insoluble calcium salts. Hydrochloric, acetic, and nitric acids form soluble calcium salts, and are most injurious; but sulphuric and fluoric acids form insoluble salts, hence their action is much less injurious, and can be practically eliminated by a light lining or by coating with tar.

Concrete smokestacks originated in the United States, but a number are now in use in Europe. The monolithic type, in which the finished stack forms a continuous one-piece structure, is often built as a simple cylinder for the sake of simplicity. Recently, however, monolithic stacks have been built to a more pleasing form, and one utilizing materials more efficiently. As the cement takes some time to set, the time occupied in and the wages charged for building are higher than for a masonry stack.

The relative accessibility of raw materials for concrete, and of formed or radial bricks for masonry stacks, frequently determines which construction is ultimately the cheaper. Generally large reinforced concrete stacks are about 20 per cent. cheaper than the equivalent masonry structure, and the weight of the former is about 40 per cent. that of a masonry stack of equal height and internal diameter—an important consideration where the subsoil is yielding in nature.

The vertical reinforcing members of a monolithic reinforced concrete stack are generally tied to a cast-iron head ring, but the metal skeleton thus completed should not be relied upon entirely as a lightning conductor. An external copper conductor should also be provided.

INSPECTION OF GOVERNMENT COAL PURCHASES.

THE inspection of coal purchased for the U. S. government is conducted from the headquarters of the bureau in Washington, where the engineer in charge of the inspection service is stationed and the laboratory for analyzing samples of deliveries is situated.

The work done includes collecting, analyzing and testing of samples representing deliveries of coal purchased under Government contracts providing for purchase on a specification basis, in order to ascertain whether the coal represented by the samples conforms to the stipulations of the contracts. On such contracts the bidders guarantee the quality of the coal they offer, and the quality guaranteed by the successful bidder becomes the standard of his contract.

A large part of the coal used by the Government for its power plants, public buildings, and naval stations is purchased under contracts that specify the ash and the moisture content, the heating values, the limits of the content of volatile matter, and the sulphur content. The analysis of samples of deliveries determines whether the quality of the coal is up to the standards guaranteed by the contractor. If it is not, the price to be paid is decreased in proportion to the lower value of the coal; if the coal is of higher quality, the price is proportionately increased.

Definite Scheme of Procedure.

In the collection of samples, a definite scheme of procedure is observed. By following the instructions of the Bureau of Mines, and by observing every practicable precaution, the collection of samples fairly representing the coal delivered is insured. The gross samples taken are reduced by successive crushings, mixings, and partings to samples that weigh about three pounds. These are sent by mail to the laboratory at Washington.

The larger part of the coal now bought by the Government is purchased under the general technical supervision of the Bureau of Mines. The cost of purchases under specifications prepared by the bureau for the use of the Government now aggregates approximately $4,500,000 per annum, and the additional fuel bought under the general advice of the bureau now aggregates in purchase cost some $3,000,000 per annum more, making a total value not less than $7,500,000.

Benefits Derived.

The benefits to the Government from this work of the bureau have been both general and special. In the case of the purchase of coal by the Isthmian Canal Commission for the Panama Railroad during the fiscal year 1910 and 1911, the money actually saved by the Government was nearly $75,000, and the real saving was probably several times these figures, because the method of purchase insured deliveries of coal of a higher grade than would otherwise have been obtained. Other examples might be mentioned, among them the savings effected by the Quartermaster Corps, War Department, which amounted to $27,500 during the fiscal year 1912.

Some benefits to the general public resulting from this work for the Government may be indicated by the fact that more than fifty of the larger cities, a number of states, and a large number of private corporations and business concerns in different parts of the country have followed the general plans adopted by the Government for the purchase of its coal. The analyses of coals from the different coal fields of the country, analyses that have been made in testing these coals for the use of the Government, have been of great service to engineers in charge of power plants and to manufacturing industries throughout the country, enabling users of fuel to determine in advance the character of the coals available for local or special use. The specification method of purchase protects the Government against the delivery of poorer coal than that guaranteed by the contractor and incites dealers to prepare the coal more carefully.

In the case of coal for use on naval vessels, at the request of the Navy Department the mining and shipping facilities of mines from which purchase is proposed are carefully examined by the engineers of the Bureau of Mines, and the samples collected from each mine are analyzed at the Pittsburgh laboratory; in this way a standard of high-grade coal, low in ash and volatile matter, is fixed, and must be maintained in subsequent shipments. Occasionally samples are collected as the coal is being loaded on ships, and if the results show that the coal as loaded is not up to the standard, the contractor is promptly notified that the quality of his shipment must comply strictly with the contract specifications, and on his failure to ship coal of specified quality his contract is annulled. Coal purchased under such specifications and used on naval vessels amounts in round numbers to 700,000 tons a year.

The steaming tests that have been conducted and the advice given by the bureau's engineers are resulting in further economies to the Government. For instance, by a change in the kind of coal used, one Government boiler plant is spending between $4,000 and $5,000 a year less than formerly for fuel, while another Government plant reduced its annual expense for fuel about $15,000. Other examples might be mentioned.

LOW PRESSURE BOILER EXPLOSIONS.

MANY steam users are under the impression that, when boilers or vessels to which steam is admitted for heating and boiling purposes are worked at low pressure, failure cannot produce serious results, though experience often shows this assumption to be untrue. In the early days of steam many terrible boiler explosions occurred, although boilers were then of a primitive type, and pressures used only a few pounds per sq. inch, which is insignificant as compared with modern practice. In the event, however, of the sudden rupture of a large boiler, even when working at low pressure, the amount of energy liberated is capable of doing great damage.

In the May issue of the Vulcan is an illustration taken from the Illustrated London News for December 27th, 1845, showing the havoc wrought by the bursting of a wagon boiler at a cotton mill at Bolton. The boiler was of a type which was incapable of resisting a high pressure, and though the actual working load is not stated in the brief account of the disaster, it seldom exceeded 12 lb. to 15 lb. on the inch. All the same, it sufficed, as the illustration shows, suddenly to convert a large part of a four-storied mill into a heap of ruins and kill ten workpeople, while nine others were more or less seriously injured.

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Steam Boilers in Central Stations.—In a paper on "Steam Boiler Operation in Central Stations," Mr. J. W. Jackson says:—"The selection of fire-bricks is one that naturally requires very careful attention. The particular make of fire-brick to be used depends not altogether upon the quality of the brick, but to a great extent upon its character. Some fire-bricks with great reputations run to slag very quickly indeed, while, again, other fire-bricks practically unknown do excellent work with the same coal. There is, of course, no great wonder at this when it is remembered that the sulphur content of coal varies very considerably, while, again, some coals contain a fairly considerable amount of impurity, such as fire-clay. This fluxes some makes of bricks very badly, and, on examining the furnace after quite a short run, it will be found that the molten fire-brick or slag has run down the underside of the furnace arch, cutting quite deeply into the fire-brick and practically making rivers running down the side walls and on to the grates, with the result that the fires quickly get into a very bad condition, and need to be cleaned by means of a long slice as frequently as once per hour."

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Vol. VII. JUNE, 1914 No. 6

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SINCERITY ADVERTISING.

FROM June 21 to 25, the Associated Advertising Clubs of America will hold their annual convention in Toronto. Not only will new records be established in point of members attending as compared with kindred gatherings on Canadian soil, but there will be borne in upon our people with a renewed forcefulness, the fact that public mediums, whereby the products of the farm, the mill and the factory are brought vividly to their notice, are neither superfluous for their intelligence development nor given to misrepresentation or exaggeration. Relative to the foregoing, subscribers to **The Power House** are invited to take a keener interest in and develop the habit of studying its advertising as well as its editorial, the combination feature producing more immediate and greater returns.

The old order changeth, and although our policy has always been truth and sincerity at any cost, the practice has been far from universal. While appreciating therefore the general advance now being made, we simply reiterate former appeals to our readers to appropriate to themselves the benefits derivable from closely scrutinizing the offerings of those who advertise with us.

UNIFORMITY OF BOILER INSPECTION.

A UNIFORM standard for boiler inspection to govern the whole of Canada, long urged by the departments of the more energetic provinces in this respect, seems at last to be in sight. A conference of inspectors representing all but two provinces is at present in session in Toronto and if the earnestness and good-will of the delegates shown in the preliminary meetings be an indication of possible results, we are sure much needed reform will be accomplished.

The evils of the present agglomeration of standards, easily evident to the average citizen, have been exceedingly troublesome to all concerned with boiler design, construction and operation. A firm in Pittsburgh which had, after some expensive lessons, succeeded in getting their product adapted for Ontario, found different and possibly more troublesome experiences ahead of them on shipping a consignment to British Columbia. In some cases it has been more advantageous to buy boilers for British Columbia in the Western States than in the Eastern Canadian provinces, a line of action contributory usually to much heart-burning and ill-will.

The objects of the conference cannot be accomplished without difficulty on account of the wide variance of the present standards and the diversity of the ideals sought by the different representatives. Nevertheless, while the common standards adopted may not be perfect in the eyes of some, our boilers will be safe, and the educative effect of the conference cannot but raise the general order of boiler inspection throughout the Dominion. It is to be hoped that the success in this will lead to uniform requirements for engineers and firemen and other much needed standards in the engineering profession.

FACTORY ACT AMENDMENT.

AN amendment to the Factory Act in the Province of Ontario seeks to include men who operate hoisting engines within the scope of the requirement of a stationary engineer's operating license. The term "hoisting engines" is rather vague and seems to imply a complete absence of both knowledge and purpose on the part of those responsible for this projected addition to the statutes. Hoisting engines embrace a particularly wide field, some sections of which are on a par with many of our power plant units, and are no doubt considered, at least, as such by their owners in the matter of licensed competency. We presume, however, that it is now sought to include crane equipment, steam shovels, concrete mixers, etc. If this be the case, some concurrent legislation which will discriminate between man and man, and reward higher intelligence and capacity attainment should be provided.

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

STRESS ON BOLTS OF SPLIT FLY-WHEEL.

By J. R. Brodie.

I NOTICED in a recent issue of your journal a problem propounded by Mr. Westwood regarding the stresses acting on the bolts of a split fly-wheel. As such discussions tend to add to the interest in the paper, I shall endeavor to set forth my theory and a calculation. The data given are as follows:—

Diameter 12 ft., r.p.m. 150, and weight 10 tons. The hub was held intact by four 2½ in. bolts, with an initial stress in each of 1,000 pounds, and the rim was secured by four 2 in. bolts, each under an initial stress of 700 pounds.

The stress in the rim of the fly-wheel is found by the following formula (a):

$$S = \frac{R \times N^2 \times W \times F}{2 \times 3.1416} \text{ where}$$

S=Total rim stress in pounds.
R=Mean radius of fly-wheel in feet.
N=Number of revolutions per minute.
W=Weight of rim in pounds.
F=Constant for centrifugal force of whole rim=.000341.
3.1416=Ratio of circumference to diameter of circle.

The weight of the rim is not given and, for this reason, it is necessary to ascertain its stress per sq. inch.

The weight of a cast-iron rim may be found by formula:

$W = 2 \times 3.1416 \times R \times 3.125$, where
W=Weight of rim.
3.1416=Ratio of circumference to diameter.
3.125=A constant for cast-iron.
R=Mean radius of wheel.

Weight of rim$=2 \times 3.1416 \times 6 \times 3.125$ $=117.813$ pounds.

By formula (a), the total stress in section of rim one inch square and 12 ft. diameter will equal

$$S = \frac{6 \times 22500 \times 117.8 \times .000341}{6.2832}$$

= 863 pounds per sq. in.

The width of the crown and its thickness are not given. Therefore it is necessary to base the calculation for the total weight of the rim upon the assumption that the dimensions are as follows:—Width 18 in., thickness 4 in., or cross sectional area$=18 \times 4=72$ sq. in.

The total stress on the rim in pounds =sectional area in sq. in. $\times$ 863= $72 \times 863=62{,}136$ pounds.

Area of a 2 in. bolt=3.1416 sq. in., and total stress on each bolt=62.136÷4 =15.534 lbs. The initial stress on each rim bolt due to the tightening is 700 lbs.

Now, if the strains on the bolts increase in proportion to the loads they are called upon to carry, the total stress on each bolt is $15{,}534 + 700=16{,}234$ pounds. The stresses on the hub bolts, in my opinion, are very moderate, and are, therefore, not considered.

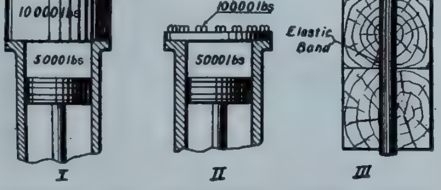
It was said by "Centrifugal" that the speed of the wheel was too high. The maximum allowable strain in a cast-iron fly-wheel rim is 1,000 pounds per sq. in., which corresponds to a rim velocity of 6,085 ft. per minute, which brings the wheel in question within safe limits. Its rim velocity is 5,655 ft. per minute, while the rim stress is 863 pounds per sq. in.

* * *

TENSION ON CYLINDER STUDS.

By N. G. Near.

I CANNOT refrain from offering my views on the cylinder cover stud question in which I agree in part with Mr. Rodgers. When steam is turned into a cylinder there must be an increase in tension in the studs, but that increase is very small in proportion to the initial tension produced by tightening the nuts.



TENSION ON CYLINDER COVER STUDS.

This pressure slightly compresses the nut and the cover and there must be some compression also in the cylinder itself. All materials, including cast iron and steel, are elastic, the stud alone being elongated. As soon as steam is turned on, a small part of the initial compression in cylinder and cover will be relieved, with the result that there will be a slight increase in the tension of the cylinder bolts, but, as mentioned before, this increase is practically negligible.

A glance at the two cylinder ends shown will make this clear. Fig. 1 is closed steam-tight by means of a 10,000 pound weight, while the joint of Fig. 2 is made in the usual way with the cover pulled down by a total force of 10,000 pounds. The nature of the pressure at both steam joints is about the same and the pressure per sq. in. of metal against metal would be computed in the same way. The real difference is that one joint is elastic and the other is not. The weight in No. 1 would not have to be increased until the total pressure of the steam exceeded the applied load. The studs, on the other hand, are stretched and the tension is correspondingly increased until the slight compression of the metal of the cylinder is relieved. After this takes place, the pressure of the head against the studs is simply transferred from the cylinder body to the steam and little further increase in tension takes place. The exact amount of the increase in tension, of course, would be hard to measure.

Another illustration is shown in Fig. 3, which consists of two blocks of wood held together by a rubber band to represent the elastic tendency of the studs and a thin sheet of rubber between them to represent the elasticity of the cylinder cover and packing. It will be found that the slightest pull stretches the outer band until the very small compression between the blocks is relieved. Beyond this the blocks will not be separated until a pull is applied equal to the tension of the band.

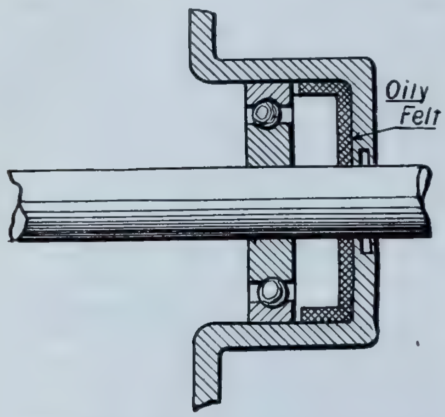
* * *

SCHEME FOR CATCHING DIRT IN BALL BEARINGS.

By N. G. Near.

TO keep dirt and grit out of your ball bearings, keep the balls covered with a thin coat of oil sufficient to prevent them rusting, and your principal ball-bearing troubles are eliminated.

Ball bearings are now made for almost every machine where minimum friction is desirable. For shafting transmission they are made particularly strong, rugged and durable. There are many varieties of dirt shields for protecting the balls and races, some of them very effective, but to be absolutely sure that a minimum of dust will filter into the vital parts, it is a good plan to glue felt around the interior of the shield as shown in the sketch herewith and make it moist with oily graphite or other lubricant that will not dry. When a dust particle enters, it will be thrown against this trap by air currents set up by the rotating balls. Thus, whether the bearing is in use or not the dust particles have little chance to get to the surfaces where harm might be done. After several years of use the felt can be rinsed clean with gasoline.



CATCHING DUST IN BALL-BEARINGS.

SOLDERED JOINT QUERY.

By J. N. Ellethorn.

ON page 163, May issue of **The Power House,** a reader wishes to know why soldered joints will not prove satisfactory on steam coil joints. Solder, commonly known as tinsmith's solder, is made from equal quantities by weight of block tin and lead. Again, plumber's solder, which is used to make wiped joints has a larger quantity of lead than tin—usually about three of lead to two of tin by weight.

Steam at 100 pounds gauge pressure has a temperature of 327.625 degrees Fah. Tin melts at a temperature of 444 degs., lead at 614 degs.; half and half melts at 466 degs., and two to one at 475 degs., Fah. In view of the foregoing, it requires no great knowledge to understand that with steam at a high temperature passing through split pipes with soldered breaks, the solder will become very soft and weak. The pressure will soon force the solder apart as the pipe expands at the break, for as the solder becomes heated it looses its power to hold together the two sides of the split.

Even on low pressure steam-pipes a soldered joint is not to be recommended as the expansion of the solder and the iron pipe is altogether different. For example: the linear co-efficient of expansion for iron for each degree increase in temperature is .00000686, for steel pipe .00000599, and for tin .00001,410. Positively no soft soldered joint should be used on a steam pipe. For hot or cold water or any cold gas pipes it is all right if the pressures or temperature changes be not too great, because the tensile strength of solder is away below that of iron.

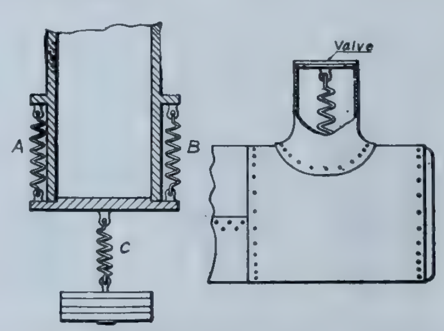
TENSION ON CYLINDER COVER STUDS.

By C. N. Roach.

IN a former issue of your journal, Mr. Rogers proved to the satisfaction of quite a number of readers that if the studs were screwed up with a tension of 1,000 lbs. each and the full steam pressure, amounting to 2,000 pounds, be turned on, the total tension in the studs would be 4,000 lbs. This I do not altogether agree with.

In my opinion there can be no increase of tension on the studs when the steam is admitted to the cylinder. This theory I illustrate with springs as substitutes for studs and the steam pressure. If the cover be held in place with two springs, A and B, each under a tension of 1,000 lbs., the steam pressure can be readily represented by regulating the tension in the spring C.

If the tension in C be raised to 1,000 lbs., the tension on the other springs will still be 1,000 lbs. each. If raised to slightly more than 2,000 lbs., we will begin to note a deflection of A and B, as this will exceed their initial tension. This should corroborate the conclusions of Mr. Jones to the effect that the tension of cylinder studs does not increase until the total steam pressure becomes greater than the tightening up tension in the studs.



TENSION ON CYLINDER COVER STUDS.

Another simple illustration is in the form of a boiler and safety valve. If there were any increase in the tension of the spring it would deflect and steam would blow off before the required pressure was reached. As the steel of the studs is more or less elastic if not seriously overworked, there is no reason why these cannot be cited as parallel cases.

ELECTRICAL FIRES.

By J. E. Noble.

In most cases the chief engineer in large office buildings and factories has charge of the electric wiring for power and light. In hundreds of cases where fires occur, the blame is wrongly placed on such wires, although on the other hand it is a settled fact that many fires are caused by wrong placing or misbehavior of conductors. When proved cases of such fires occur they should be brought to the notice of all chief engineers. The following are a few that have been reported in electro craft from time to time, and although greatly condensed, I think they contain all the information necessary to make them of value to engineers in charge.

(1)—A gas fixture had been removed from a corridor on the upper floor and the wires left lying against a gas pipe. The insulation becoming old, the bare wire came into contact with the pipe, and there being a ground already on the service, an arc was formed. A small hole was burned in the pipe and the gas ignited.

(2)—A 500-volt motor was installed in a small room in a grain elevator. Dust was allowed to accumulate and was ignited by sparks from the brushes. A dust explosion followed.

(3)—Several distribution feeders to lights were run in paper conduits. Some of these conduits were in a channelway adjoining a metal lined air shaft. In fastening the metal lining in place, the nails were driven into the channelway and through the paper conduits containing rubber covered wires. The vibration of the building caused the nails to wear away the insulation of the wires. The arc thus formed set fire to the insulation, to the paper conduits leading to the air shaft, and finally appeared in the attic of the building. Tests made subsequently showed that a 50-ampere fuse in the feeder wires would not blow before a fire was started in the channel-way.

(4)—Cables in a tunnel leading from a large generating station were bunched closely together instead of being properly separated. Ashort circuit occurred on the system and produced such a heavy rush of current in the cables of the tunnel that their insulation melted away, exposing the bare copper. A very vicious arc was formed, and the insulation caught fire, which was in turn communicated to the power house.

(5)—A fire took place in a dwelling where unenclosed plug fuses were placed in the attic. A short circuit occurred at a fixture which blew the fuses, set fire to some wearing apparel and then to the building.

(6)—Old-style insulating joints for combination gas and electric light fixtures allowed gas to escape, which was ignited by small sparks between a grounded wire system and the fixture. The fire was thought to be extinguished, but crept along the insulation of the wires (weatherproof) in a furred wall and broke out later in the attic.

In some of these fires, damage to the extent of $200,000 was done, making it apparent that it pays to look carefully after the wires.

◆

CONCERNING BOILER INSPECTION AND ENGINEERS' CERTIFICATES.

By H. W. Benton.

Why do steam boilers explode? Did you ever ask yourself that question, and have you ever arrived at an explanation that satisfied you? Did you every know, read, or hear tell of a boiler explosion that did not (according to the newspaper) have low water, or an incompetent attendant, as its cause? Of all the boilers that have exploded, few of them were, I believe, operating with low water at the time. All boiler explosions are a result of over pressure: more strain than the shell can stand, hence a rupture of the metal and an explosion.

I believe, however, that low water is a contributing cause to explosions. A boiler may at some time have had low water and, as a result, the exposed sheets below the fire line may have been burnt, thus weakening the plate; yet this same boiler might run months after the sheets were burnt and not show any leak or sign of defect. A defect, nevertheless, exists, and a small crack may start along the sheet and slowly grow in length and depth until some day, when the boiler is steaming under perfectly normal conditions, it will have developed until the plate is too weak for the pressure and fractures. Low water may thus be the cause leading to an explosion, although not the actual condition when it occurs. Again, there may be defects in the longitudinal shell seams that defy attention, that gradually develop until the plate is weaker than the force which it was designed to withstand. We have here another cause for explosion, in which low water does not enter. A boiler explosion is, therefore, a direct result of too much pressure, regardless of whether that pressure was 100 lbs. per sq. in., or only 30 lbs. per sq. in., because from some cause or other the strength of the plate or seam has become weaker than the force it has to withstand, and a burst shell is the inevitable result.

To me there is no mystery about a boiler explosion, except the mystery that there are not more explosions, considering the way some boilers are operated.

Pertinent Example.

I have in mind a return tubular boiler about 40 in. diameter by 12 ft. long, that had a crack about 10 in. long at the furnace sheet. A small hole had been drilled in each end of the crack and then a patch had been fitted on to the bottom of the shell with boiler-patch bolts. The patch got leaking, and the owner did not wish to do anything towards repairing it except feed bran to the boiler.

The fireman was a youth of fair intelligence and had to work for his bread and butter, and although he did not really know, he felt that the bran cure was only adding weight to the millstone that was likely to land the whole outfit at the bottom of Davy Jones' locker. The leakage grew so bad that in the night time the water would leak out enough so that in the morning there was no water in the glass and no way to get any more in except by carrying it in pails and pouring it through the safety-valve. The owner ordered that the boiler be fired up **easy**, mind you, with no sign of water in the glass, and that as soon as there was steam enough to put the injector on, and just fire up enough to run the injector until water showed in the glass.

This plan was followed for several days without any trouble, until eventually the engine was put on before water was in the glass, and the owner said **it will all come right.** At 11 a.m. there was still no water to be seen and the injector had been on full all the morning. Examination showed all tubes to be leaking so badly at the back end that the wonder was there was any water at all in the boiler. A shut-down was ordered, the patch tightened up, the tubes rolled and beaded, and steam gotten up next day as usual. This boiler was installed in a small foundry and machine shop.

Upon another occasion the owner decided to clean out the boiler, so at night he drained all the water out of it. The next day the machine shop man, requiring some power, lit a fire under the empty boiler, and when after some time there was no steam, he looked into the furnace and found the plates red hot.

The foregoing goes to show that it is small wonder that more boilers do not explode, and indicates also, that better boiler inspection laws, together with a better Stationary Engineers' Act are urgently required, so as to eliminate the ignorance and carelessness which lead to boiler explosions.

In the **Hamilton Spectator** a few weeks ago, there appeared an article from the Toronto correspondent stating that the Boiler Inspection Act would likely be widened so as to include Government inspection of every steam boiler in use in Ontario. It stated further that the present Act only provides for the inspection of boilers during construction or repair, but if the present proposed additions became law, all boilers in use in the Province of Ontario will be inspected at least annually, including those in theatres, churches, and public buildings. Dangerous boilers will be condemned, and overtaxed boilers will be penalized down to a pressure allowance that will make them safe. Meantime, a great number of boilers, many of them operated so long that they are a continual menace to life, are allowed to stay on as they are with only the inexpert and perfunctory inspection they occasionally receive under the Factory Inspection Act. To the average person and to the public in general, this article would seem to point out that our operating engineers are a very careless, ignorant, untrustworthy lot, who take great chances on themselves every day with such menaces to life; also that one is taking quite a risk when anywhere near a steam boiler.

That the Province of Ontario needs better protection from boiler explosions is a very great truth, but the widening of the Boiler Inspection Act will do very little towards that end, unless the Stationary Engineers' Act is also made a real Act.

Insurance Company Inspection.

That the great majority of boilers in Ontario need inspection and receive that only under the provisions of the Factory Inspection Act is not altogether true. There are at least three boiler insurance and inspection companies with offices in Toronto, and these concerns have each a number of inspectors continually on the road doing boiler inspection only. The Government could not make a better showing than these men make, because since these people get along with very few losses, it indicates clearly that they know their work, and that the great majority of boilers in our midst are not as risky as we might be led to believe.

There is no doubt, however, that there are many boilers that receive only the Factory Act inspection, and "perfunctory" is the correct word to describe this.

Engineers' Examinations.

The Ontario Government proposes to inspect our boilers and advise if they are safe or not to operate, and under what conditions they shall be operated. They also advise that if our boilers are over 50 h.p. that we must employ a certified engineer to operate them. The examination questions used to ascertain a man's fitness to act and be certified as an engineer are about as much good as questions pertaining to dressmaking would be if applied to test a man's fitness to act as an admiral of the United States navy. The present examination questions for certificates are not even a fair examination for a fireman, to say nothing of an engineer.

I am an advocate for better boiler inspection; it cannot be too strict, or too complete, and I also strongly condemn the present standard of **Stationary Engineers' Certificate** in Ontario, and state positively that unless the Stationery Engineers' Act is improved and made what it should be, any improvement in the Boiler Inspection Act will fall short of its otherwise success. It is a joke, an insult to the intelligence of any real engineer, to be handed an Ontario certificate, as the best the province has to offer.

The Engineers' Act should provide graded certificates, with provision for limiting the power, of which a man could assume charge, and these should consist of first class, second class and third class certificates issued as follows:—

An applicant for examination to state his experience, age, and whether or not he has made a study of steam engineering apart from his daily work.

A candidate to have two years' experience as an oiler or fireman under a certified engineer before being eligible for examination; and to have seven years' experience in all for first class unlimited certificate.

By this system a two-year experience man, even though he be perfect theoretically, could only get a third-class certificate, but by working two years on the third-class certificate he could be examined for second-class. By obtaining this and operating three years on it, or seven years in all, a satisfactory examination would get him a First Class unlimited certificate. Thus, a man all college and no practical experience could not get a fifst-class certificate without the latter, neither could a man with 40 years' practical experience and no technical training get first-class. To be awarded a first-class certificate, a man should have a proper mixture of theory and practical experience, a dual attainment which all right-thinking people agree is essential.

This system would work no hardship on anyone, would be a protection to the public in general, the employers and the engineers themselves, and would raise the standard of engineers generally, while incidentally tending to reduce the number of boiler explosions. Let the third grade certificate acquirement be made fairly easy, but make it a real examination for a first-class certificate. Employers would soon come to acknowledge the certificate as a worthy representative of a man's ability and one to be relied upon, instead of as to-day, **"nothing to go upon at all."**

The Province of Ontario has a Stationary Engineers' Act, the results of which are almost as bad as no law at all, and while better boiler inspection is desired and required, good operating engineers are needed also.

UNIFORM BOILER RULES FOR ALL CANADA.

Representatives from every province in the Dominion, with the exception of Alberta and Manitoba, are meeting at the Parliament Buildings, Toronto, to consider uniform boiler inspection regulations for all Canada. At the present time Alberta, Saskatchewan and Ontario have uniform regulations. British Columbia has regulations that vary somewhat; Manitoba is about to adopt a series, while the other provinces are merely in the "considering" stage.

The conference is of considerable importance to boiler manufacturers, and their representatives will doubtless keep closely in touch with the sessions. If uniform regulations are adopted it will mean that boilers inspected and passed upon during construction can be sent to any part of the Dominion and put into operation without further inspection or suffering any penalty in pressure imposed as a safeguard.

Those attending the conference are J. Peck and R. N. Blackburn, chief inspectors of boilers in the Provinces of British Columbia and Saskatchewan respectively; W. G. Matthewson, of Nova Scotia; P. T. Tobin, inspector of public buildings, Province of Quebec; and D. M. Medcalf, chief boiler inspector, Province of Ontario.

FRACTURED CRANK SHAFT.

After working some considerable time, a large crank shaft fractured through an arm of the crank connected with the high-pressure cylinder. Under shock tests it showed up badly, and its microstructure indicated that it had been overheated. From the indicator diagrams and the weight of the moving parts, the stresses existing in the crank shaft were calculated. The results show that the stresses were not high enough to account for fracture, assuming that the engine had been properly assembled when new. The positions of the bearings, however, had not been happily chosen, which would give rise to greatly increased stresses after wear had taken place, e.g., a wear of 3 mm. on the end—fly-wheel—bearing would just about double the stress on the crank arm which ultimately fractured.

FORCED DRAFT AND ECONOMIZERS.

At a recent meeting of the Chicago Section of the American Society of Mechanical Engineers, "Large Steam Power Plants" was discussed. W. L. Abbott, of the Chicago Commonwealth Edison Co., spoke very strongly in favor of economizers and of mechanical draft, and as this company is one of the largest central stations in the world, and as Mr. Abbott is one of their most prominent engineers, his words are worth noting. In connection with boiler operation, Mr. Abbott stated as follows:

"Air is taken at a normal temperature, heated up to 2,000 or 2,500 deg. and cooled down to 500 or 600 deg. The rest of the heat is used to create a draft—that is, the air is driven up a smokestack, pulling fresh air after it through a fuel bed. To use 20 per cent. of the heat of the fuel merely to push air through the fuel bed is a wasteful process. It is true that the temperature of the water in the boiler is some 400 deg., and cannot cool down the air. The remedy is to use economizer and cool down the furnace gases to the lowest point possible. Abolish smokestacks for the purpose of creating draft. Boilers are being forced 100 per cent. every day, and, with forced draft, from 300 to 400 per cent. Still the limit has not been reached. The boiler can be cut in two, and a half of it forced to 500 per cent. if necessary. The other half could be used as an economizer in two stages if need be, and the gases cooled to the temperature of the feed water. In this way there is a possible saving of 20 per cent."

Such bold statements in favor of economizers and of forced draft are becoming more and more common, and it is undoubtedly due to the fact that economizers have accomplished marvelous fuel savings. Considering this tendency, it seems likely that few draft chimneys will be built in future. Even where chimneys are now used, we frequently find economizers and induced draft being installed.

In Canada the preference for preheating by economizers is very markedly on the increase. A majority of the plants in the lumber, pulp and paper industry are economizer-equipped. At the present writing, the Brompton Pulp and Paper Co. are installing a 1,200-b.h.p. economizer at East Angus, P.Q.; the Belgo-Canadian Pulp and Paper Co., a 750-b.h.p. economizer at Shawinigan Falls, P.Q.; the Toronto Housing Co., a 450-b.h.p. economizer at Toronto; and the Canadian Kodak Co., a 1,200-h.p. economizer at Toronto. The B. F. Sturtevant Co. of Canada, Ltd., of Galt, Ont., is making all three installations.

Instruction Course for Power Plant Operators--II.

By M. L. Smith, B.A.Sc.

Throughout the writer's experience as a teacher, he has been continually confronted with the query: "Can you recommend a text book for power plant employees?" This, on account of specialization of the different branches of the work and the fact that most books published deal with methods of particular localities, is practically impossible. This series of articles is intended to supply the need, to set forth the technical points so that firemen and engineers can understand and apply them, and be thereby assisted in passing the various qualifying examinations.

THE student at this stage should observe that every kind of engine cannot be fully explained, and that limited space allows only to be discussed the foundation types which most clearly show the principles involved. The young engineer should make a point of being present when engines, pumps, etc., are being taken down, and by a willingness to be of service, put himself in the way of learning what there is to know without asking too many questions. A great deal is also to be gained by visiting other plants in spare time, and becoming acquainted with other engineers.

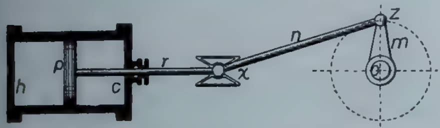


FIG. 5.—FOUR LINK SLIDER CRANK.

Classification of Engines.

Steam engines may be classified in many different ways. The following, however, embraces practically all that are in use at the present time.

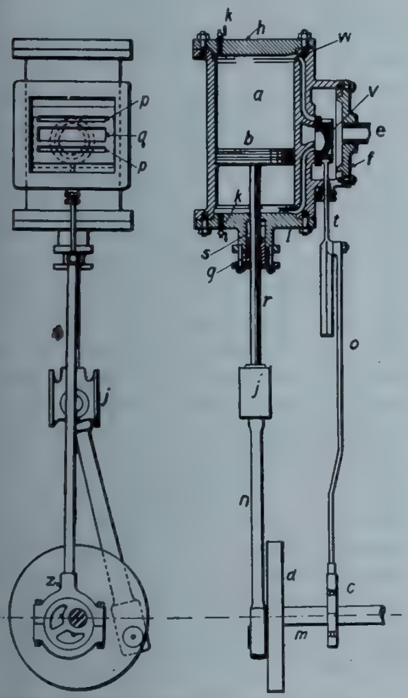


FIG. 6.—THE SIMPLE SLIDE VALVE ENGINE.

(1)—According to number and arrangement of cylinders—Simple, compound, triple, quadruple, duplex, etc.

(2)—According to the type of valve used—Plain slide valve, automatic cutoff, Corliss, etc.

(3)—According to kind of service—Locomotive, marine, stationary, portable, etc.

(4)—According to general method of operation — Reciprocating, oscillating, rotary, turbine, etc.

Definition.—A simple engine is one in which the steam is worked in one stage, and usually in one cylinder. There may be several cylinders, but if each is fed with live steam, that is, steam directly from the boiler, or if each cylinder is supplied with steam at the same pressure, they will form parts of a simple engine. The same engine may belong to all of the above classes, thus a simple engine may be plain slide valve, stationary and reciprocating. All of these classifications except the last are either self explanatory or will be thoroughly explained later in the course.

Definition.—A reciprocating engine is one in which some of the main parts move to and fro. Reciprocating parts are those which move backwards and forwards; thus, the moving parts of an engine are spoken of as reciprocating and rotating.

An oscillating engine cylinder is pivoted at its center so that it rocks about this point instead of having a connecting-rod. This rocking motion also looks after the steam distribution, so that the engines consist simply of a cylinder, piston with rod and crank. They are used mostly for elevators, carriages in lumber mills, etc.

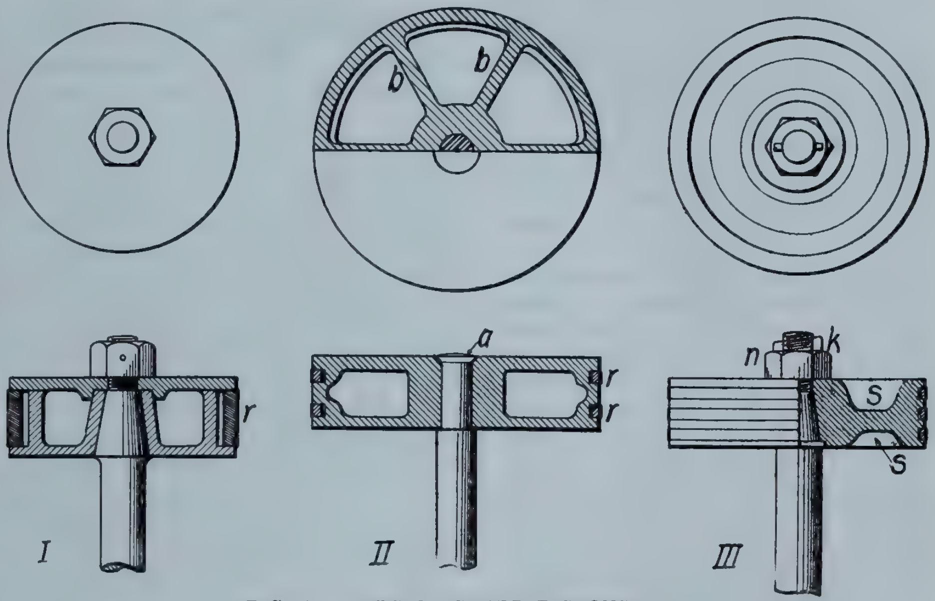


FIG. 7.—TYPES OF SMALL PISTONS.

A rotary engine is one whose main parts rotate or move in a circle. It uses the direct pressure of expanding steam in the same way as a reciprocating engine, and usually consists of sliding vanes in a revolving drum placed eccentrically in a cylinder, or it may have the verolving drum in the center of an oval cylinder.

A turbine is similar to a water wheel in that it makes use of forces of impulse and reaction in which steam takes the place of water.

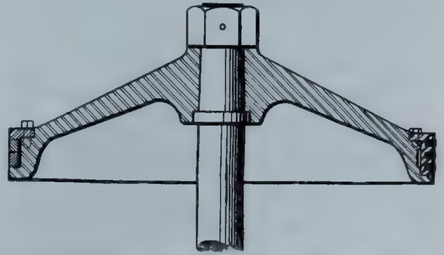


FIG. 8.—LARGE PISTON WITH JUNK RING

It may be said by some that the reciprocating slide-valve engine is going out of use. Nevertheless, it still predominates, and as its working is comparatively easy to understand, and its principles largely underlie all steam engines, it will be carefully explained here.

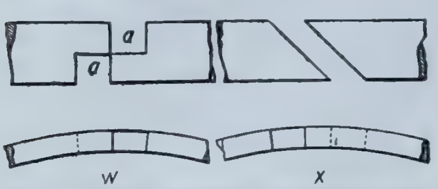


FIG. 9.—SIMPLE FORMS OF PISTON RING JOINTS.

The simplest form of the steam engine is known as the four-link slider crank motion as shown in Fig. 5. It consists primarily of the cylinder (c) in which the steam is expanded, pushing the movable partition or piston (p) ahead of it; thus both the piston and the rod (r) are forced to move in a straight line in one direction. If now the steam which caused this motion be allowed to escape and fresh steam be admitted to the other end of the cylinder, the piston will be forced back to its starting point or will move in a straight line in the opposite direction. This constitutes the reciprocating motion. The link (n) is known as the connecting-rod, because it connects the back and forth motion to the circular motion. Its purpose is to change reciprocating motion at (p) to rotary motion of the shaft (o). The fourth link (m) is called the crank. Its business is to force the end of the connecting-rod to move in a circle.

Construction.

Fig. 6 shows two views of a simple slide-valve engine, the one on the left having the valve removed in order to show the ports. The cylinder (a) is made of cast iron, and is bored straight and smooth. It should be of a slightly harder and closer-grained grade of iron than the piston and should be made of an even thickness to prevent warping. The piston (b) is also cast iron and is turned to a loose fit in the cylinder. Fig. 7 shows several common types of small piston heads, (1) being a built-up piston which is held together by the same nut that fastens the head to the rod. This kind of taper fit is not good, as with both the steam pressure and the tension of the nut it is liable to act like a wedge and burst the head; (2) represents a solid, box type piston shrunk on the rod, which is then riveted over. This is also poor practice and is allowed only on small or cheap work. A very good method is shown in (3) for fitting rod and piston together, except that most men prefer a pin threaded through the nut instead of the key shown. The fault with this piston is that it is difficult to make the cylinder heads (h) and (i), Fig. 6, to fit closely around them, and the clearance space is made unavoidably large.

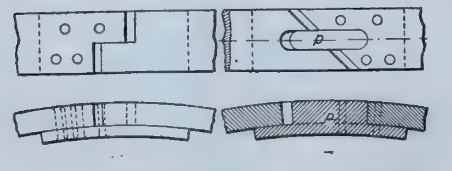
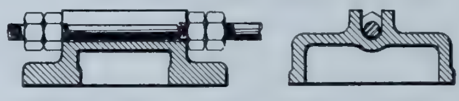


FIG. 10.—IMPROVED FORMS OF PISTON RING JOINTS.

Piston heads are kept steam-tight by means of packing rings fitted into turned grooves. These rings are turned slightly larger than the cylinder bore; an amount equal to about 1-16 inch for each inch of diameter of cylinder being cut out. The ring is compressed to a smaller circle and again turned to fit the cylinder. When in place, it tends to spring out against the cylinder walls and to wear to a perfect steam-tight fit.



SIMPLE FORM OF "D" SLIDE VALVE.

Two of the simplest ways of splitting rings are shown in Fig. 9. The parts (aa) are the portions cut out. It is easily seen that, as a joint, neither of these is very good, as a small amount of steam can leak down one space (a) and up the other. This is prevented by riveting brass plates on the back as shown in Fig. 10. The piston head shown in Fig. 8 is a type much used for high pressures and large cylinders. The cone shape is for the sake of strength. A great advantage is that the packing rings are held in place or are carried by a junk ring which permits of their removal without withdrawing the piston.

At the other end of the piston-rod, Fig. 6, is the cross-head (j) which makes a hinge joint between it and the connecting-rod. This particular type is known as a Corliss cross-head, and its guides as Corliss guides. The length of the connecting-rod should be at least 3½ times that of the crank, and the bearings should be so arranged that this length from center to center does not change with wear. The crank (d) is made up of the crank-arm and crank-shaft (o). In high-speed engines the crank-arm is usually in the form of a flat disk with the crankpin shrunk in, being thereby much more conveniently balanced or counter-weighted than a plain arm.

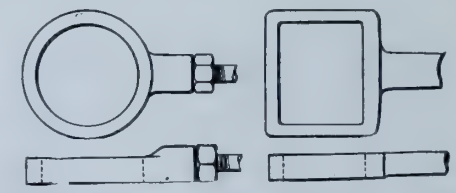


FIG. 12.—TYPES OF VALVE YOKES.

It is particular to notice that the eccentric (e), Fig. 6, is really a small crank whose purpose is to give a reciprocating motion to the valve (v). A simple form of D valve is indicated in Fig. 11, which is intended to show the method of attaching the valve stem (t), Fig. 6. It is desirable to be able to adjust the length of the valve stem, and the valve should be free to adjust itself up and down to accommodate wear. In this case the stem adjustment is by means of nuts. Fig. 12 shows two forms of yokes which fit over bosses on the back of the valve.

It will be observed that the valve seat containing the steam ports (pp) and the exhaust port (q) is made short enough to allow the valve to slide completely over its face, and thus prevent the formation of ridges at the ends of the valve travel. For the same reason the cylinder is bored larger at the ends to form the counter-bore (w). The edge of this counter-bore should come to the center of the outside piston ring when the engine is at either end of its stroke. The whole valve mechanism, including eccentric and strap, eccentric rod, valve-stem, valve, etc., is known as the valve gear. The front end of the engine is called the crank end and the rear the head end. The length of the movement of the piston in one direction is called the stroke and the chamber from which the steam is distributed to the cylinder is known as the steam-chest.

* * *

Tube Failures.—It was the custom at one time to ascribe all tube failures in water-tube boilers to bad workmanship in the welding of the tubes. Since the introduction of seamless tubes this excuse is no longer available, and other causes have been sought and found. An examination of a large mass of material relating to tube failures has proved that the true cause of these failures is most usually impure feed water, either alone or in conjunction with imperfect combustion, due to badly designed grates and combustion space. Too often the baffling of the gases, with the introduction of secondary air, occasions a completion of the combustion process and great increase of temperature, after the gases have passed up to the boiler tubes —hence overheating occurs, especially where impure feed water is being used and the tubes contain deposits of scale. The remedy for tube failures is, therefore, to use chiefly pure water from condensers freed from oil, in conjunction with ordinary feed-water supply, after chemical treatment to free it from the scale-forming salts.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent, practical questions, and give same direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

BOILER QUESTIONS FOR ENGINEERS' EXAMINATIONS.

Question.—In taking charge of an engine and boiler plant, what would be the proper way to proceed?

Answer.—Observe the water level, trying gauge cocks and blowing out glass if necessary. Note steam pressure; try injectors or see that feed pumps are working properly. Feel all important bearings and see that lubricating apparatus is in good order. It is the duty of the engineer going off watch to turn the plant over acceptably to the man coming on.

* * *

Question.—What is a good way of banking a fire?

Answer.—Push the live coals back against the bridge wall so as to leave the forward part of the grate covered with ashes. Cover the fire with a fairly thick layer of fine coal and some ashes. Leave the damper open a very little to prevent the collection of gas and possible explosion. When starting up it is simply necessary to pull the fire evenly forward and shovel on fresh coal.

* * *

Question.—How are pipes and tubes measured?

Answer.—Pipes are measured by the inside diameter and tubes are gauged by the outside diameter.

* * *

Question.—What points should be observed in connecting up a water column to a boiler?

Answer.—Connecting pipes should not be smaller than one inch in diameter and preferably of extra heavy pipe or drawn brass tubing. Bottom pipe should be connected with a ground joint brass union so that the bottom of the water glass or the bottom gauge cock will be at least 1½ inches above the top row of tubes. Plugged tees should be used instead of elbows to allow cleaning. The bottom pipe should be level and fitted with a gate valve blow off.

* * *

Question.—Is there any difference in the speed with which water and steam will escape from the same boiler?

Answer.—Yes. Volume for volume, the steam will escape about twenty times as fast as the water.

* * *

Question.—What is the effect of an accumulation of scale and soot on a boiler?

Answer.—A coating of soot or scale is a bad conductor of heat, hence heat is prevented from getting to the water and to get the same amount of steam from the boiler, extra coal is needed thus:—1-16 inch of scale necessitates 15 per cent. extra fuel; ⅛ inch of scale necessitates 32 per cent. extra fuel; ¼ inch of scale necessitates 66 per cent. extra fuel; ½ inch of scale necessitates 150 per cent. extra fuel.

* * *

Question.—How would the heating surface of a return tubular boiler be determined?

Answer.—Multiply the inside circumference of one tube in inches by its length in inches and by the number of tubes. Divide this by 144, which will give the number of square feet of heating surface supplied by the tubes. From the area of one end subtract the combined area of the tube ends all in inches and divide by 144. This will give the heating surface of the tube sheet. Multiply two-thirds of the circumference of the shell in inches by its length in inches and divide by 144. The result will be the heating surface of the shell. The sum of these three will be the total heating surface of the boiler in square feet.

* * *

Question.—In examining the interior of a boiler what are some of the defects to be looked for?

Answer.—(a) Loose and broken stays and loose rivets, (b) effects of corrosion such as pitting, grooves, etc.; (c) Fractured, burned and laminated plates; (d) Defective blow off connections; (e) Thin and defective tubes, etc.

* * *

Question.—What should be the chief aim in firing?

Answer.—To secure a complete combustion of the fuel including soot and gases and at the same time to permit as little excess of air in the furnace as possible as this simply carries heat up the stack.

* * *

Question.—What is meant by the water circulation of a boiler?

Answer.—Water is really a poor conductor of heat and must therefore be heated by passing rapidly over the heating surface so as to expose all its particles to the heat. When water is heated it expands, becomes lighter and rises while, at the same time, cold water rushes in to take its place. The current thus set up is called the circulation, and the stronger the current the better.

* * *

Question.—How should a pump be located with reference to the water supply to feed hot water to the boiler?

Answer.—The pump and water tank should be so arranged that the water will flow to the pump by gravity.

* * *

Question.—Will a pump lift hot water? If not, why?

Answer. — No. Theoretically cold water can be lifted about 34 feet. As the temperature is raised this height is decreased until at or near the boiling point it cannot be lifted at all. The reason is that the hot water easily changes to steam at the lower pressure of the suction and this steam instead of solid water fills the cylinder of the pump.

* * *

Question.—What is the method of procedure in setting the valves of a duplex pump?

Answer.—First take off steam chest covers and set both rocker arms exactly plumb. Measure carefully the width of steam ports and place both valves centrally over ports. Set up jam nuts to within half the width of the ports from the valves and lock them in this position. Valves should move in opposite directions to open ports. Replace covers and pump is ready to start.

* * *

Question.—What points should be observed in shutting a plant down indefinitely?

Answer.—Before blowing off, fill the boiler fairly full and put about a gallon of crude oil into the steam space so that, as the water goes down, a coat of oil will be left on the inside of the boiler to prevent rust. Clean oil out with soda when starting up again. Clean boiler thoroughly. Clean soot from flues and furnace parts and cover with a coat of boiled linseed oil. If boiler cannot be emptied, fill up completely with water with the addition of soda ash. Boil off air and close up tight. Cover stack top with water-tight hood if possible and arrange to prevent dampness from entering through breechings, holes in the roof or elsewhere.

* * *

Question.—What are some of the causes that may prevent an injector from working?

Answer.—Leak in suction pipe, too low steam pressure, foaming boiler, dirt such as scale iron, red lead, etc., in tubes, strainer getting clogged up, loose lining in suction hose, bad check valve, etc.

* * *

Question.—What is meant by hard and soft scale and how should each be treated?

Answer.—Hard scale is composed of the sulphates of lime and magnesia. These are dissolved in the water when cold, but settle in the form of a very hard limy coating on the tubes and shell at a temperature of about 300 degs. F. By adding the proper amount of soda ash to the feed water these materials are precipitated as a sludge which may be blown out. Soft scale is composed of the "carbonates" of lime and magnesia. These begin to settle in the form of a soft mud at about 200 degs., and are gotten rid of by frequent blowing off.

* * *

Question.—When is the best time to blow off the boiler?

Answer.—In the morning before heavy steaming begins and the sediment is stirred up.

* * *

Question.—How is it that a pump will force water into a boiler against a pressure equal to or greater than the steam which runs it?

Answer.—The area of the steam piston is always greater than the area of the pump plunger so that if the pressure per sq. inch on piston and plunger be the same, the total pressure will be greater on the steam end than on the water end.

* * *

Question.—What is the proper way to operate a scum cock or surface blow off?

Answer.—The valve should be opened for a few seconds every fifteen minutes rather than for a long period at infrequent intervals.

* * *

Question.—Why is it wrong to feed much cold water or to let much cold air into the furnace and over the fire?

Answer.—Some parts of the boiler become much colder than others; the expansion of the different parts is unequal and the strains set up are always sufficient to tear the material. Comparatively small changes of temperature will, if often repeated, produce leaky joints, rivets, etc.

◆

UTILIZATION OF EXHAUST STEAM

SOME valuable data as to the advantages realizable by utilizing, in steam-turbines, the steam now wasted at many collieries and iron works were included in a paper read before the Nottingham Society of Engineers on March 11 by Mr. W. C. Mountain, M.I. Mech. E. The steam consumption in the case of a 750 k.w. plant working under different conditions was said to be as follows:—

WITH DRY SATURATED STEAM SUPPLIED AT 70 LB. GAUGE PRESSURE.				
Vacuum		26	27	28
Consumption at full load	lb. per kw. hour	30.5	26.8	25.0
Consumption at three-quarter load	lb. per kw. hour	29.5	27.8	26.0
Consumption at half load	lb. per kw. hour	32.2	30.3	28.3
WITH EXHAUST STEAM AT 16 LB. ABSOLUTE.				
Vacuum		26	27	28
Consumption at full load	lb. per kw. hour	39.3	36.5	31.7
Consumption at three-quarter load	lb. per kw. hour	41.0	37.1	33.1
Consumption at half load	lb. per kw. hour	44.2	40.0	35.7

As illustrating the amount of exhaust steam available at collieries, Mr. Mountain gave the following figures of the consumption of non-condensing winding engines in different cases:

Size of Winding Engine. in.	Consumption per Shaft Horse-Power.	Boiler Pressure.
32×72	129	...
45×84	83	80
18&28×84	177	140
36½×78	114	60
36×78	95	180
32×72	70	120
40×78	48	105
32×72	102	80
36×72	129	80
22×52	58	100
40×78	88	100
26×54	43	127
60×84	178	20

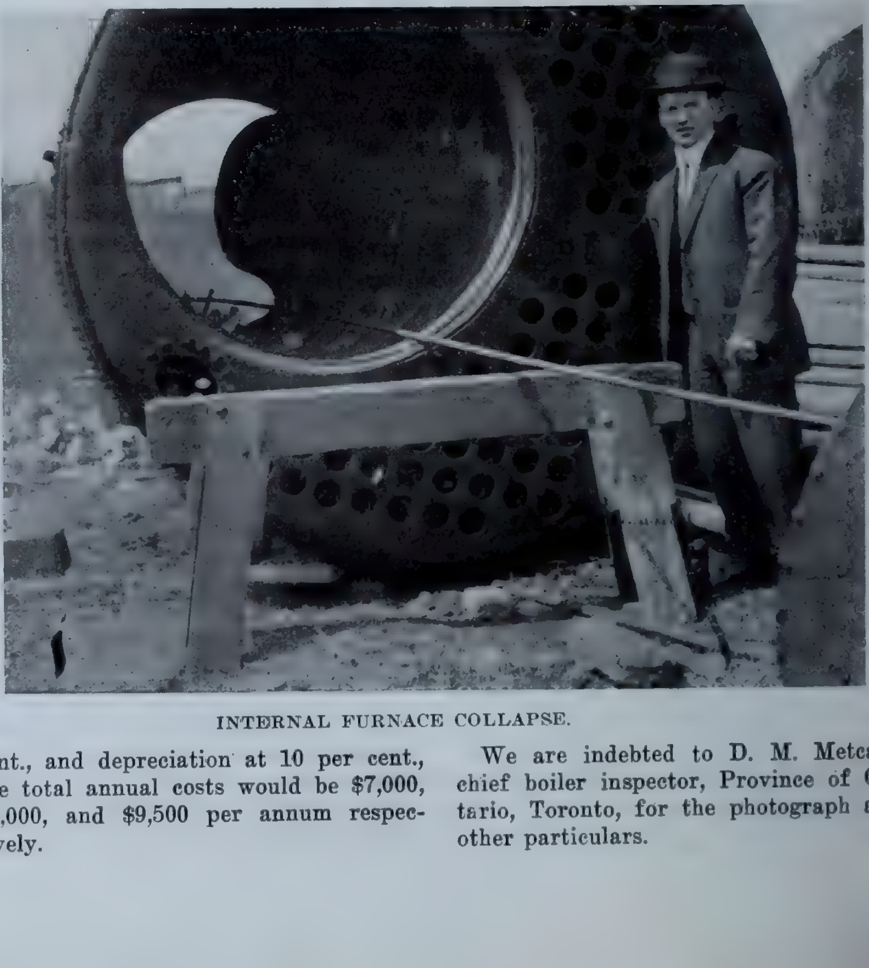
The cost of a mixed-pressure turbo-generator plant with condenser and all accessories was stated to be about $30,000 for a 500 kw. installation; $35,000 for a 750 kw. plant; and $42,500 for 1,000 kw. unit. Taking interest at 5 per cent., and depreciation at 10 per cent., the total annual costs would be $7,000, $8,000, and $9,500 per annum respectively.

In this estimate no allowance is made for the value of the waste steam. The cost per unit with a load factor of 100 per cent. would be .152, .116, and .104 cents for the three plants respectively, which, if a stand-by plant were also provided, would be increased by about 50 per cent.—Engineering.

◆

INTERNAL FURNACE COLLAPSE.

The accompanying illustration shows the collapsed (Morrison) internal furnace of a 150 h.p. dry-back marine type boiler, being the result of shortness of water. The collapsed portion embraces about one-half of the circumference and the whole length (13 ft.) of the furnace, while its depth amounts to 34 ins., being only limited in this respect by the resistance of the fire-grate when the crown give way. It is worthy of note that although much burned and stretched, no trace of rupture was apparent in the plate material, indicating a high durability under extremely severe conditions. The furnace was 52 ins. mean diameter by 13 ft. long, and of 7-16 in. steel plate.



INTERNAL FURNACE COLLAPSE.

We are indebted to D. M. Metcalf, chief boiler inspector, Province of Ontario, Toronto, for the photograph and other particulars.

Arithmetic for the Machinist and Operative-Engineer

By J. H. Rodgers

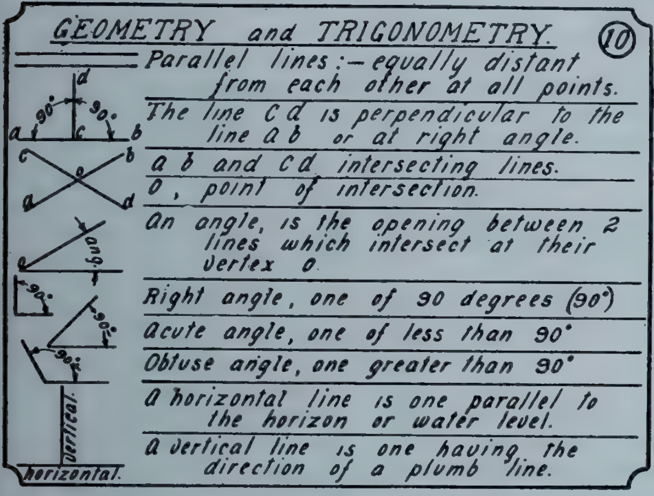
With the further development of this course in arithmetic, it will be found by those who have followed the introductory lessons and profited by them that the various practical applications resulting from the succeeding lessons will be easily observed and their time and labor-saving features so appreciated as to be adopted at every available opportunity.

GEOMETRY.

GEOMETRY is that branch of mathematics which treats of the properties of lines, angles, surfaces and volumes.

A point indicates position only; it has neither length, breadth nor thickness, while a line has only one dimension—length.

Parallel lines are equally distant from each other at all points, and a line is perpendicular to another when it meets it and forms two angles of 90 degrees each.



Parallel lines:—equally distant from each other at all points.

The line c d is perpendicular to the line a b or at right angle.

a b and c d intersecting lines.

o, point of intersection.

An angle, is the opening between 2 lines which intersect at their vertex o.

Right angle, one of 90 degrees (90°)

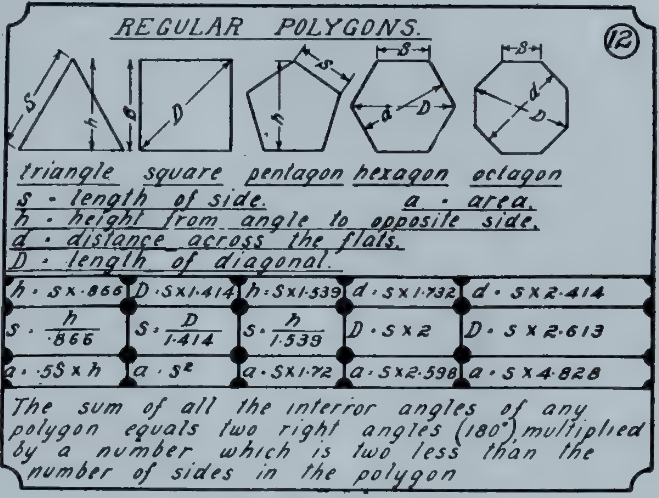
Acute angle, one of less than 90°

Obtuse angle, one greater than 90°

A horizontal line is one parallel to the horizon or water level.

A vertical line is one having the direction of a plumb line.

ARITHMETIC CHART 10.



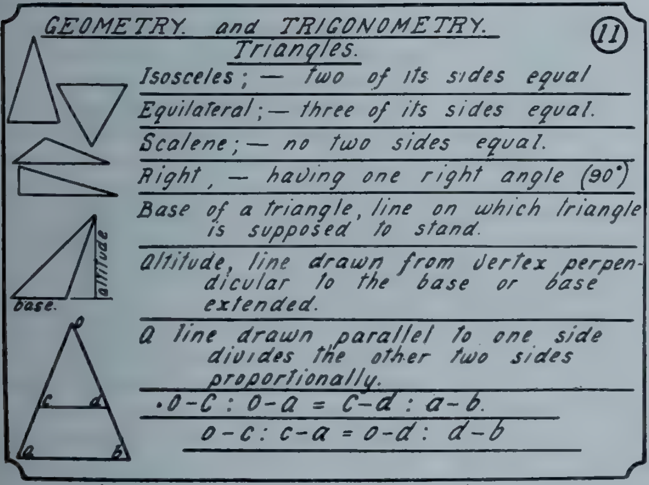
s · length of side. a · area.
h · height from angle to opposite side.
d · distance across the flats.
D · length of diagonal.

triangle	square	pentagon	hexagon	octagon
$h \cdot S \times .866$	$D \cdot S \times 1.414$	$h = S \times 1.539$	$d \cdot S \times 1.732$	$d \cdot S \times 2.414$
$S \cdot \frac{h}{.866}$	$S \cdot \frac{D}{1.414}$	$S \cdot \frac{h}{1.539}$	$D \cdot S \times 2$	$D \cdot S \times 2.613$
$a \cdot .5S \times h$	$a \cdot S^2$	$a \cdot S \times 1.72$	$a \cdot S \times 2.598$	$a \cdot S \times 4.828$

The sum of all the interror angles of any polygon equals two right angles (180°) multiplied by a number which is two less than the number of sides in the polygon

ARITHMETIC CHART 12.

A horizontal line is one parallel to the horizon, or water level.



Triangles.

Isosceles;—two of its sides equal

Equilateral;—three of its sides equal.

Scalene;—no two sides equal.

Right,—having one right angle (90°)

Base of a triangle, line on which triangle is supposed to stand.

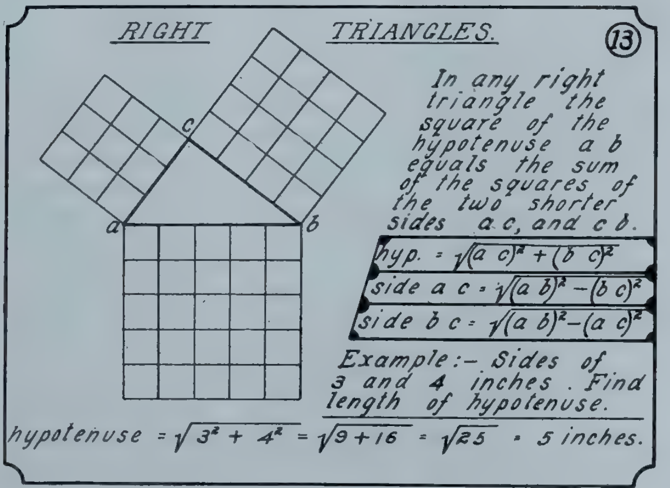
Altitude, line drawn from vertex perpendicular to the base or base extended.

A line drawn parallel to one side divides the other two sides proportionally.

$o{-}c : o{-}a = c{-}d : a{-}b.$

$o{-}c : c{-}a = o{-}d : d{-}b$

ARITHMETIC CHART 11.



In any right triangle the square of the hypotenuse a b equals the sum of the squares of the two shorter sides a c, and c b.

hyp. = $\sqrt{(a\,c)^2 + (b\,c)^2}$

side a c = $\sqrt{(a\,b)^2 - (b\,c)^2}$

side b c = $\sqrt{(a\,b)^2 - (a\,c)^2}$

Example:—Sides of 3 and 4 inches. Find length of hypotenuse.

hypotenuse = $\sqrt{3^2 + 4^2} = \sqrt{9+16} = \sqrt{25}$ = 5 inches.

ARITHMETIC CHART 13.

A vertical line is one having the direction of a plumb line, or is at right angles to the horizontal. Intersecting lines are those that cross each other.

An angle is the opening between two lines that meet at the vertex of the angle. (See Chart 10).

When expressing an angle by the use of figures or letters, the vertex is always denoted by the middle letter, as (a.o.b.), (o) being the vertex of the angle.

A right angle is one of 90°.

An acute angle is one of less amount.

An obtuse angle is one exceeding 90°

When one line meets another and forms two adjacent angles, these two angles will equal two right angles.

When one line crosses another and forms four adjacent angles, the sum of the four will equal four right angles.

Plane Figures.

A plane figure is any part of a plane surface bounded by straight or curved lines.

A polygon is a plane figure inclosed by straight lines.

The perimeter is the sum of the bounding lines.

A regular polygon is one in which all the angles are equal, and all the sides are of equal length. Several regular polygons are shown in Chart 12.

The Triangle.

Triangles are of four kinds; isosceles, scalene, right angled and oblique angled.

An isosceles triangle is one with two of its sides equal, and when three of its sides are equal, it is called an equilateral triangle.

A scalene triangle is one in which no two sides are of equal length. This also applies to an oblique triangle.

When one of the angles is a right

angled triangle the triangle is called a right triangle, and the side opposite the right angle is called the hypotenuse.

The altitude of a triangle is the perpendicular height from the vertex to the base or base extended. (See Chart 11).

The sum of the three angles of any triangle equals two right angles.

In any right angle triangle the square of the hpyotenuse equals the sum of the squares of the other two sides. (Chart 13).

Example: What is the length of diagonal of a square with 3 inch sides?

By formula, Chart 13, the diagonal or hypotenuse $= \sqrt{(ab)^2 + (bc)^2} = \sqrt{3^2 + 3^2} = \sqrt{9 + 9} = \sqrt{18} = 4.242$ inches.

A triangle, whose sides are proportionally the same as those shown on Chart 13, will form a right triangle, thus, sides of 3, 4 and 5 or 9, 12 and 15 etc., will form similar triangles, although varying in size.

To prove this, draw the straight line (ab), 15 inches long. From (a), as a centre, with radius of 9 inches describe an arc, and from (b), with radius of 12 inches, describe an arc intersecting the other arc at (c); then (acb) will be a right angle or 90°.

By figures, we have, from Chart 13, hypotenuse $= \sqrt{(ac)^2 + (bc)^2} = \sqrt{9^2 + 12^2} = \sqrt{81 + 144} = \sqrt{225} =$ 15 inches.

Again side ac $= \sqrt{15^2 - 12^2} = \sqrt{225 - 144} = \sqrt{81} = 9$ inches, or side bc $= \sqrt{15^2 - 9^2} = \sqrt{225 - 81} = \sqrt{144} = 12$ inches.

* * *

READERS' QUERIES.

Editor Power House:—I would be much obliged if you would answer through the paper the following problems:

(1)—How would you determine the crushing strength of a plain furnace?—A. Langridge.

Answer.—Formulae for the determination of the strength of furnaces and flues cannot be deduced by direct reasoning, and are, therefore, the results of experiments. The most used formula, known as Fairbairn's, is $p = 9{,}675{,}600\dfrac{t^{2.19}}{l\,d}$

Where p=pressure in lbs. sq. in.

t=thickness of metal in inches.

l=length of flue in inches.

d=diameter of flue in inches.

For all practical purposes t^2 may be used instead of $t^{2.19}$ and the formula becomes $p = 9{,}675{,}600\dfrac{t^2}{ld}$

The British Board of Trade prescribes the following formula for welded flues:

$$p = \frac{90000\,t^2}{(L+1)\,d} \quad L = \text{length in feet.}$$

For lap joints and inferior work the 90000 may be reduced as low as 60000, according to judgment of the engineer.

Example.—What would be the crushing strength in pounds per sq. in. of a flue ½-in. thick, 10 ft. long and 30-in. diameter?

From formula, $p = 9.675600 \times \dfrac{(\frac{1}{2})^2}{10 \times 12 \times 30}$

or $p = 9{,}675{,}600 \times \dfrac{\frac{1}{4}}{10 \times 12 \times 30} = 671.6$ lbs. sq. in.

Or the working load using a safety factor of 6 would be $\dfrac{671.6}{6} = 112$ lbs. sq. in approximately.

(2)—How do you determine the load that can be supported at the centre of an iron beam, the tensile strength of the material being known?

Answer.—The standard beam formula is $\dfrac{M}{S} = \dfrac{I}{C}$

In which M=maximum bending moment. This depends upon the manner and amount of loading. For a concentrated load in the centre of a beam the bending moment would be $\dfrac{PL}{4}$ where P=load and L=length. If the weight of the beam itself is to be considered the bending moment of the beam or dead load would be $\dfrac{WL}{8}$ where W = total weight of beam and L = length. For total moment these two should be addea together.

S = maximum tensile stress in the material in pounds per sq. in.

C = the greatest distance from the centre of the beam to the outside.

I = moment of inertia, the value of which can be found in most engineers' or steel hand-books. Thus, for a rectangular beam placed on edge I would be $\dfrac{6d^3}{12}$ where b = breadth and d = depth.

For regular rolled sections, the values of I for all sizes are given in the steel hand-books.

Example.—What concentrated load could be supported by a steel beam placed on edge, 1 x 6 x 4 ft., between supports. Allowable stress=20,000 lbs. sq. in.

Formula, $\dfrac{M}{S} = \dfrac{I}{C}$ or since $M = \dfrac{PL}{4}$

Formula, $\dfrac{PL}{4S} = \dfrac{I}{C}$ or $P = \dfrac{I \times 4S}{CL}$

$$I = \frac{bd^3}{12} = \frac{1 \times 6^3}{12} = \frac{1 \times 216}{12} = 18$$

C = 3 in.

S = 20000.

L = 48 in.

or $P = \dfrac{18 \times 4 \times 20000}{3 \times 48} = 10000$ lbs.

or half a ton.

Note.—In this case the weight of the beam is not considered.

* * *

Editor Power House:—I have charge of a plant consisting of a boiler rated at 100 h.p., and steaming under 125 lbs. pressure, together with a Robb-Armstrong 11-in. x 12-in. high-speed shaft governor engine running at 278 r.p.m. I do not know the point of cut off, as it varies with the load. There is driven from this a Westinghouse 55 k.w. generator, which is never more than half loaded, and part of the time is not developing more than 5 k.v.a. Could I make a saving by placing a reducing valve on the steam line and using the steam at 60 or 70 pounds pressure?—C G., Innisfail.

* * *

SELECTION OF CHAIN GEARING.

A PAPER upon "The Selection of Chain Gearing" was read before the Birmingham and District Electric Club recently. The author stated that the chief factors affecting the question of chain gears were power, speed, gear ratio, the position of the drive, the distance between the shafts, and the direction of rotation. Much valuable information was included upon the design of chain drives, and convincing examples showing the savings in power and increased efficiency were given and illustrated by lantern slides. Notes upon the treatment of chains and the use of shock absorbers and fly-wheels were given. The importance of adequate lubricating arrangements and the advisability of gear cases where possible was emphasized, as affecting the life and satisfactory running of the chain. Figures were submitted showing that in many cases the first cost of a chain drive was lower than a belt or rope drive, while the life of a chain was invariably greater than the life of ropes or belts.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

TWO USEFUL AUTOMATIC APPLIANCES.

RONALD TRIST & Co., Lloyd's Ave., London, England, are putting on the Canadian market two automatic machines of interest to steam users. They are known as "Thermofeed" boiler-level regulator, and the "Thermofeed" differential pump governor.

The first of these, which has been in use for over three years, is intended to keep the level of the water in a boiler to one constant height; and does this, irrespective of the pressure or temperature of the steam. The differential pump governor on the other hand is a more recent invention. It has taken years to evolve, and numerous experimental machines have been made. The first completed one was put to work last September, and it has continued in service day and night ever since. Its object is to so regulate the movements of a feed pump or other steam driven force pump, that it shall stop or slow down, when it has done its required work, and shall automatically restart itself directly there is need for it to do so. Its movements depend on the pressure in the main, into which the pump discharges; and, like the boiler-level regulator, its adjustment is simple and reliable.

The Boiler-level Regulator.

In every boiler there is a height at which, if the water level is kept constant, the fullest efficiency is obtained from the fuel consumed. The reasons for this are obvious, because in every boiler there is a fixed grate surface or furnace area capable of yielding a certain heat, with any given fuel; the result of careful design of flues, draught area, and other factors, thereby assuring the complete combustion of the fuel to the end that the heat-units are all set free, and made capable of doing useful work.

The erratic influx of any body of water, not exactly balancing the heat which is being set free in the furnaces at that moment, means a partial wasting of heat, for if too little water be fed, the supply is not sufficient to absorb all the thermal units which are being given off from the fuel; consequently the chimney temperature will rise, with a direct loss of efficiency. Again, if too much water be fed, the supply of thermal units is insufficient to maintain the rate of evaporation at the temperature, consequently the pressure falls.

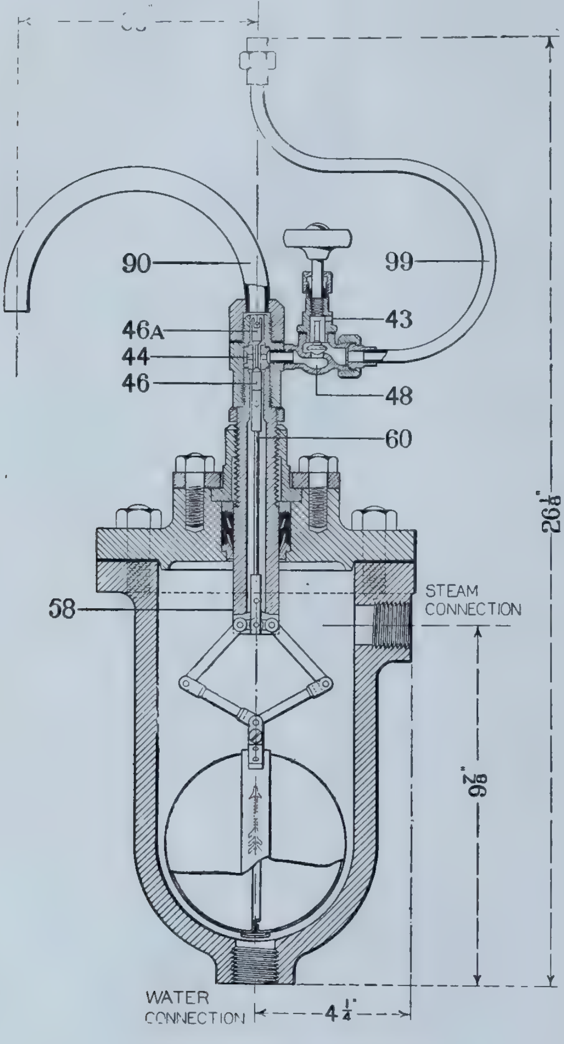
To regain the original pressure or prevent its dropping, the fires have to be forced, and again there is a direct loss; as this forcing does not and cannot coincide with the rate of feed. Extra fuel is thus consumed to attain what normal firing with a normal level would have acomplished, and goes to prove that if the water-level in a boiler can be maintained at its most economical fixed height, without any fluctuation, a saving in fuel must necessarily result.

It is quite impossible to keep an obsolute constant water level by hand, because some actual departure from the level must have taken place before the attendant would be justified in altering the feed. The repeated waste which takes place, when an attendant deliberately allows the water level to get alternately above and below the most economical height, in order to relieve himself from constant watchfulness, must be apparent to everyone who is interested in the subject.

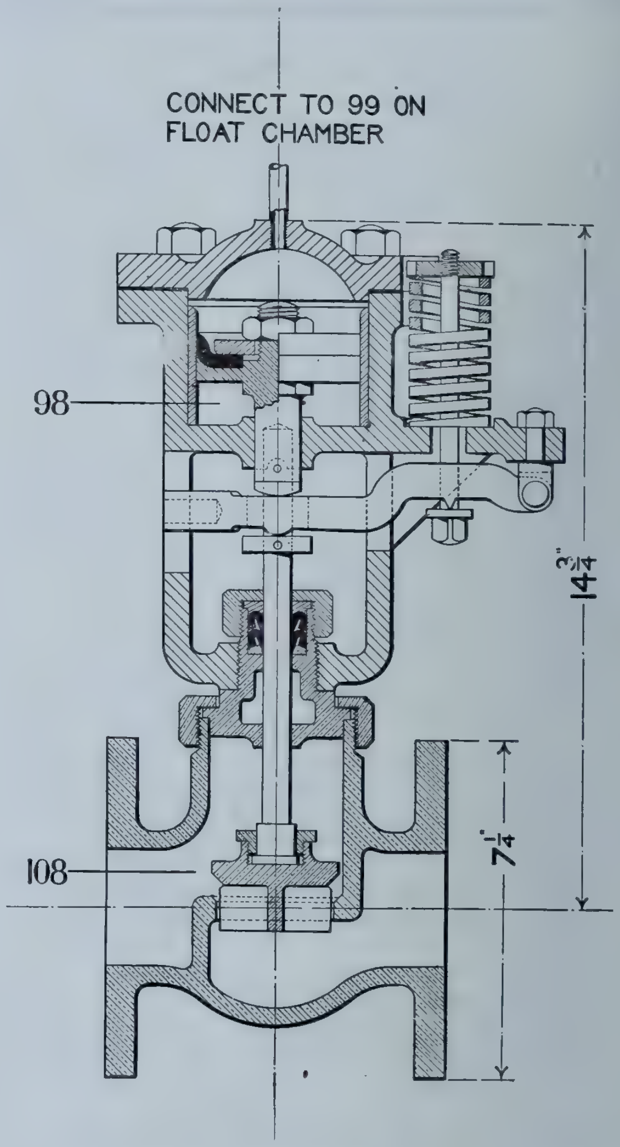
The level at which the water should stand, has always been carefully calculated by the designer, and it is usually marked on the boiler. It is then left to an attendant (who frequently has to stoke, and look after other boilers, or perhaps to do other work) to keep the water as nearly at this level as he can. Under these circumstances it is clear that a variation of an inch or more in the water-level will frequently occur, several times in an hour, and if the amount of water in a boiler be always varying from an excess to a deficient quantity, some of the heat units are merely used to increase the temperature of the flue gases, or are spent in elevating the temperature of a body of water up to evaporation point; instead of actually producing steam at the required pressure. This goes to show that a machine which will prevent any departure from a fixed level, irrespective of what horse-power the boiler is developing or what quality or quantity of fuel is being used, should be considered as an absolute necessity, provided that it is cheap, durable, and reliable. Thermofeed regulators have, we understand, now been in use on several hundred boilers and it is claimed have shown themselves to possess the foregoing qualities.

The apparatus as illustrated, consists essentially of three parts—the float, the relay valve, and the control valve. The cup-shaped cast iron float chamber is fixed outside the boiler, in such manner that the upper part is connected with the steam space, as near the top as convenient, and the lower part, well below the water level. In this chamber is a spherical float, made of spun copper, surrounded by a ring of electrolytically deposited copper, thus ensuring hermetical sealing. Above the float chamber is a relay valve, operating a control valve on the feed pipe to the boiler, and one of the improvements to the present type of regulator is that the relay valve is in a vertical position, far removed from the water surface, so that no dirt or sediment can reach it. The connection between the valve rod and float is by means of toggle levers, so that as the float rises, the valve rod is drawn down. The connection between the upper end of the toggle levers and the valve rod is adjustable, by which means after the float chamber has been fixed to the boiler and tried, the height at which the admission will be cut off, may be varied by several inches.

This adjustment can take place whilst the instrument is under steam, by merely turning the nut at the top of the sleeve with an ordinary spanner, the valve being raised or lowered as desired. When the injectors or feed pump have to be started or stopped by hand, it is difficult for the most careful engineer to decide within half an inch, at what level the boiler is being worked most economically, but with the thermofeed regulator this, it is claimed, can be done to an eighth of an inch, and in a very short time. With feed water at the same temperature and fuel of the same quality, the machine may be set to maintain that height continuously.



THERMOFEED IN SECTION.



THERMOFEED REGULATING VALVE IN SECTION.

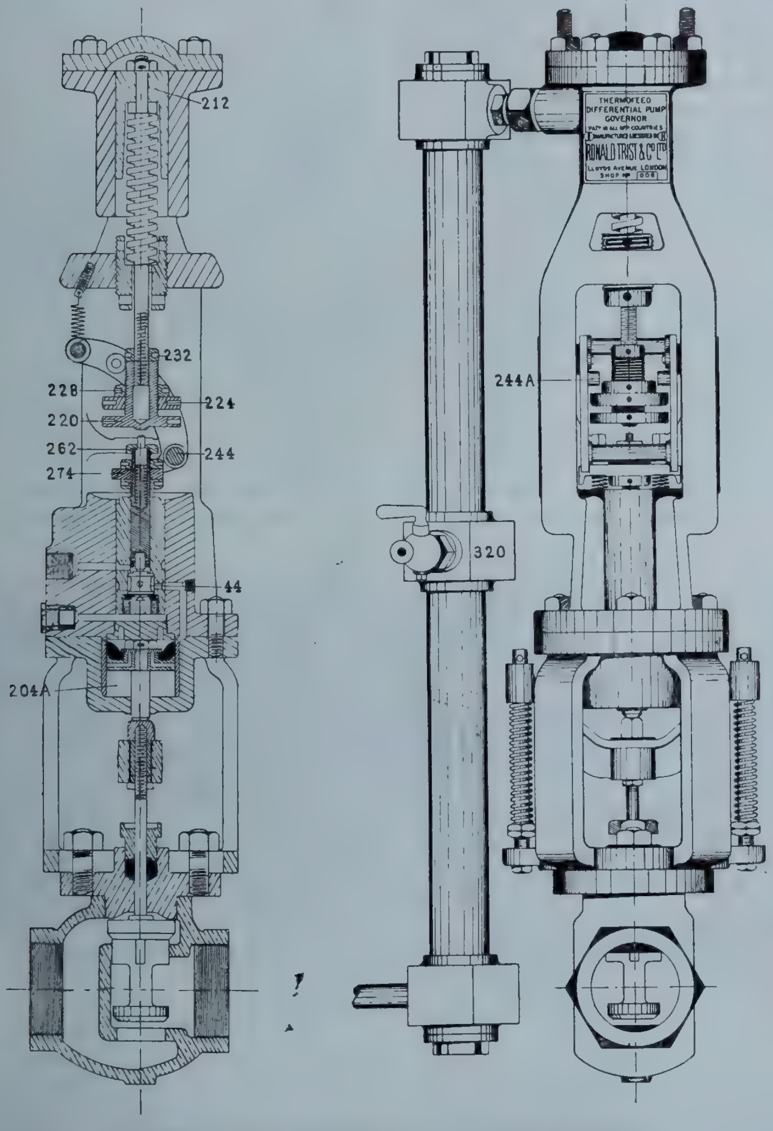
The relay valve which is actuated by the toggle levers is a mechanism which has been patented in all manufacturing countries. It forms an important part, both of the boiler feed regulator and the differential pump governor, and it applicable to many other machines. Described briefly, it is a double valve which performs all the functions of a three-way cock. It is absolutely frictionless, and consists of a circular block of phosphor bronze bored through at its vertical and horizontal axis; the holes, and a lateral recess, forming the ports. The flat surfaces top and bottom form valve seats. A rod of 99 per cent. nickel forms one conical valve and spindle, screwed at the upper end. A continuation of this rod forms another conical valve, and is drilled and tapped to receive spindle. This spindle is passed through the vertical hole in the bronze block, and the upper valve is screwed down and secret riveted to fix it to the permanent travel required. The block is 11-16 ins. long, and 9-16 ins. diameter; the valves and spindle when in position measure 1⅝ in. in length, and the whole weighs less than 1½ oz. The movements of the float are diminished in the ratio of 10 to 1, and are transmitted through the toggles and the rod to this valve.

If the water-level and float fall, the valve is raised upwards to its lower seat, closing exit of steam through this, and simultaneously putting the cylinder 98 on the other part of the apparatus in direct communication to atmosphere through ports in the relay valve and the exhaust pipe 90. If the water level and the float rise, the valve is pulled downwards on its upper seat, thereby permitting the passage of steam through the lower valve on to the piston in the cylinder 98, in this way gradually depressing the main regulating valve 108 on to its seat. The regulating valve 43 is a double valve. When on the outer seat, the cylinder is placed in communication with the relay valve, and the regulator is in commission, but when on the inner seat, the cylinder is placed in connection with the atmosphere, thus putting the "thermofeed" out of action. This allows for hand feeding if occasion should arise to alter the water-level of the boiler.

The Differential Pump Governor.

As soon as the boiler level regulator had been put on the market, Messrs. Trist set themselves to solve the question of automatic feeding under every possible condition. With a constant supply, the action of the regulator was all that could be desired, but in the case of a feed pump supplying a single boiler, it was seen that when the water is suddenly shut off by the regulator that there must necessarily be back pressure in the pipe which connects the feed pump with the boiler. They concluded, therefore, that if they could also govern the feed pump, the whole installation would be absolutely automatic.

In seeking to govern the feed pump of a single boiler, it was found that the same principle was applicable to every power-driven pressure pump of any type, and working under any conditions of pressure or temperature. Also, that there was no reason why the governor should not serve equally well when fluids other than water were being pumped. The problem to be solved was to design a machine which would control the work of a pump exactly as it would be done by an experienced mechanic, who gave it his undivided attention. It should be allowed to work at its normal speed as long as it was pumping against a normal pressure, but when this pressure became excessive the pump should either be stopped or its speed reduced. Again, when the pressure had fallen as much as was thought desirable the pump should recommence work. It was incumbent that this machine should be small, light and inexpensive, yet strong and of simple construction, with few working parts, and these easily accessible.



THERMOFEED DIFFERENTIAL PUMP GOVERNOR.

The general arrangement of the thermofeed differential pump governor may be seen by the illustrations. It is fixed in any convenient position on the steam supply pipe, stands 22 in. above this, and is about 5 in. across the widest part. It is placed in communication with the main feed pipe by means of a ¼-in. tube, which leads to the bottom of a hollow column, shown on the left of the illustration. Half-way up is a petcock, and the water is not allowed to rise above this level. The rest of the column is filled with cylinder oil, and at the top there is a screw stopper and a cross tube connecting it with the upper part of a cylinder. Thus, the pressure of water in the main passes up the column, and exerts a downward thrust on the upper surface of the piston head of this cylinder, and consequently on the piston rod and its connections. It also, in lowering the piston, compresses the spring which surrounds the rod. The lower end of the piston rod is screwed, and carries a thread which has an external and an internal thread. On the illustrations will be seen four disks, with holes for a tommy-bar. The lower disk forms part of the piston head, which can be screwed up and down on the rod, while the upper one is a lock nut, which keeps it in position when set. The two intermediate disks are carried on the threaded piston head, and can travel up and down on it.

Below this piston head is the spindle of a control valve, which is exactly similar to the relay valve used in the boiler feed regulator. It is actuated by the piston head, which, in descending, depresses it, but it is not connected with it. Immediately underneath is a smaller cylinder, to which steam is admitted by the control valve. This presses on a piston directly over the rod or spindle of the double-beat throttle valve, pushes it down, and so cuts off the steam supply to the pump. It will be observed that there are three independent units on one frame, and that through them the pressure in the water pipe is ultimately transmitted to the steam valve by direct movement. The lifting of each separate piece is performed by nickel steel springs, which are all duplicated, with the exception of that which raises the upper piston.

It will be seen that by raising or lowering the head of the upper piston on its rod the pressure at which the steam shall be shut off may be varied. Consequently, in setting the machine the piston head is first screwed up or down, till it will shut off steam at exactly the required pressure, as shown on the gauge. It is then secured in this position by its lock nut. The re-admission is regulated by the intermediate disks with the aid of a trigger piece, shown on the illustration on either side of them. This consists of two quadrant-shaped pieces of steel, which are connected by short rods, riveted over at the ends and working on a pivot. The lower points of the quadrants are curved sharply backwards, and on the inner side are pins or projections just above the lower of the two intermediate disks or nuts. The upper of these, which is of a smaller diameter, so as to clear the pins, is merely a lock nut for the other. When the piston is at its highest position the nut holds up the trigger by means of the projections, but as it comes down, the lower ends descend with it, till the curved points passing on either side of the rods lock the control valve and spindle in the down position. The closing of the control valve will cause the pressure to drop, and the upper spring will then lift the piston and its head, with the disks that are carried on it, though the trigger will prevent the control valve from rising and admitting steam to the lower cylinder. As the pressure diminishes, the upper piston continues to rise, till the lower of the intermediate disks comes in contact with the projections on the trigger. Still rising, it pushes up these projections, thus releasing the trigger. It is clear, therefore, that the pressure at which the trigger shall be released can be varied by screwing the disk up or down, and when it has been set to the desired pressure and fixed by its lock nut it will not vary with months of work. When the trigger has been lifted, springs raise the spindle of the control valve, closing the steam admission and relieving the pressure in the lower cylinder to atmosphere. The piston of the cylinder is then lifted by its springs, and the valve on the steam supply is again opened. However long the period either of work or stoppage, it makes no difference to the governor, which will not fail, it is claimed, to stop or start the pump at exactly the agreed pressures.

The saving of water, fuel, and of excessive wear to all parts of the pump are obvious, but the sense of security which this little machine gives to an engineer in charge renders it valuable, even if there were no saving in using it. However far the pump may be from the source of power and the point of delivery, he can set the governor, and be sure that it will do its work. As the liquid which is being pumped does not come in contact with the mechanism, the governor may be used for brine, sugar solutions, glycerine, caustic soda, etc., and for water at any temperature and and pressure.

The principle of this machine is capable of extension in many other directions, the details of two of these being as follows: A pump is required to remove liquid from a deep reservoir, but to stop before it runs dry. It has been arranged that the governor shall automatically stop the pump when the depth at the bottom of the reservoir is less than a stipulated number of inches, and shall re-start at any desired height. Another interesting application is that of fire-sprinklers. When these are started at an outbreak of fire the pressure will drop, and yet that is just the time when an increase would be desirable. The differential governor has been so arranged that it will render this service.

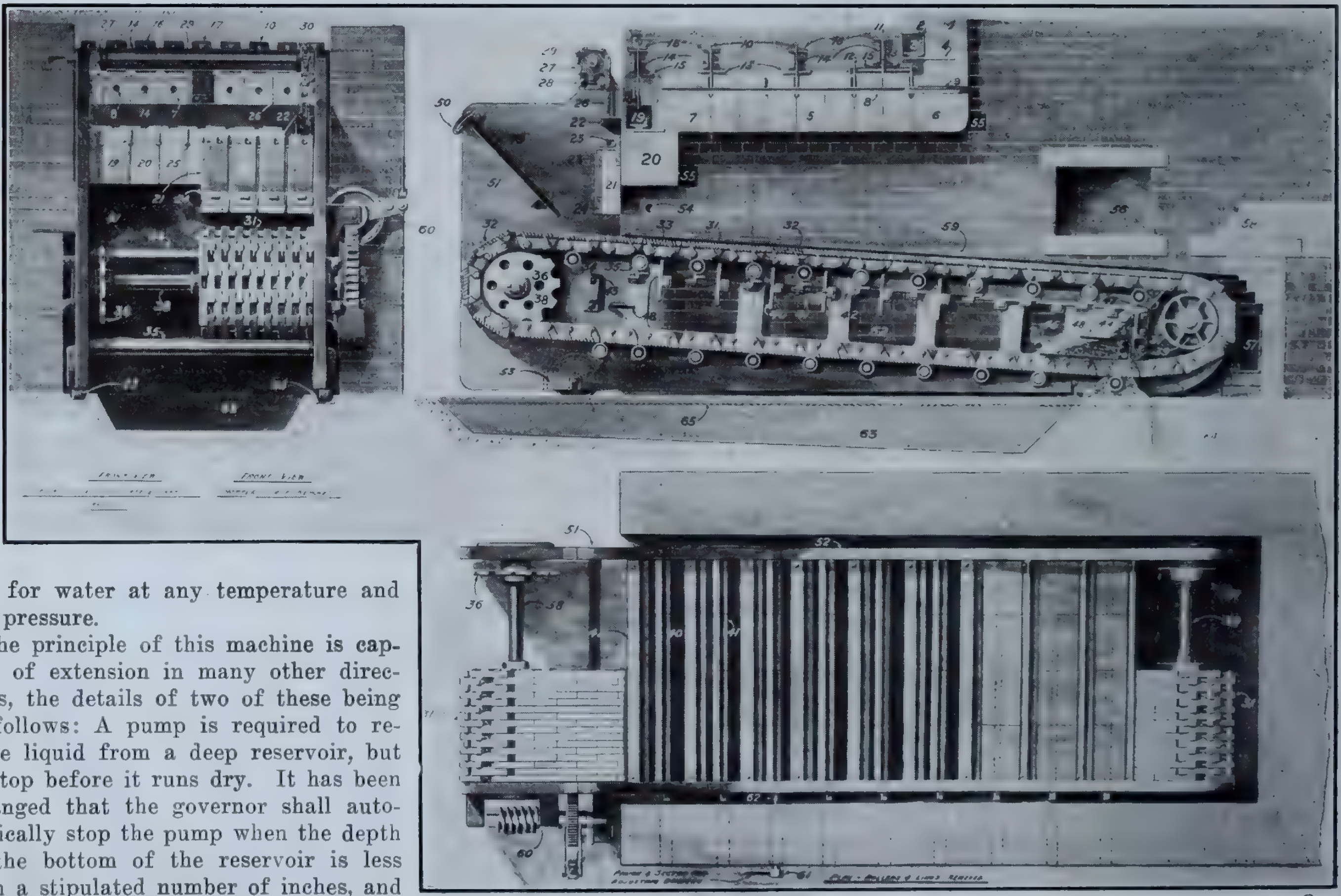
* * *

THE ILLINOIS CHAIN GRATE STOKER.

The new model of the Illinois chain grate is shown in the accompanying sketches. The side frames are most liberally designed, and are firmly connected and held at right angles to the drive shaft by means of front and rear cross braces. These side frames are at right angles to the drive shaft and carrying rollers, every second carrying roller being a tight roller, and consisting of a pipe spreader, about which the carrying roller revolves. The side frames are tightly drawn against this spreader by means of rod bolts. In addition to these spreaders, diagonal braces provide an excellent means of squaring the frames perfectly. The frames thus connected and mounted on wheels form a self-contained unit which can be moved on rails into or out of the setting at will. The tops of the frames are protected by brickwork built up on ledge plates flush with line of moving chain. The links of which this chain is built are 9 in. long, a length which experience has shown to be right for resisting the destructive effect of the fire.

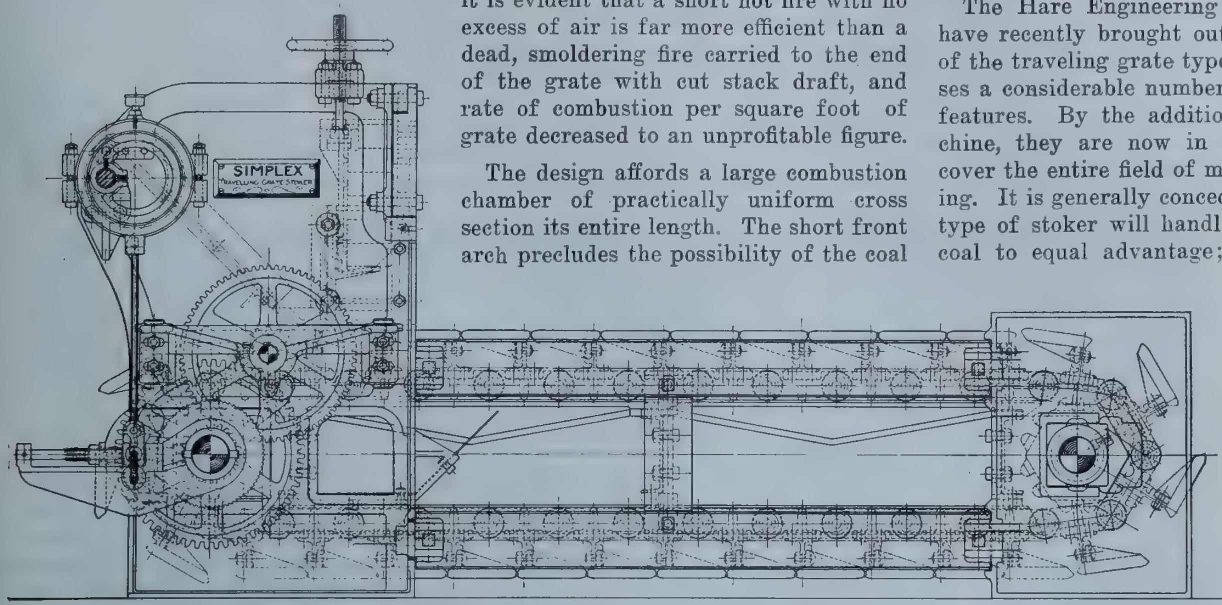
A feature worthy of note is the inclination of the air slots. These, on opposite sides of links sloping in opposite directions, offer a marked resistance to the sifting of fine coal through the grate without reducing the available air space. The air space in the standard links is 23 per cent. Should a link break, the insertion of a repair link is accomplished without delay or inconvenience. This link is made in two parts, with open rod holes. The halves are slipped into place, a pin is driven through a hole cored in the head of the links, their ends are pushed into a slight depression, and the damage is repaired.

The chain rods are cylindrical, the advantage of round rods being that they can turn and thus expose all portions of the surface to wear. Further, there is no danger of links becoming locked. The chain is driven by sprockets keyed to the front shaft, while on the rear shaft are idler drums, these being kept in place by set collars. The driving mechanism consists of a ratchet and pawl, and worm and worm wheel, by means of which combination the grate can be run at five different speeds. The principal advantage of the worm and worm wheel is that



THE ILLINOIS CHAIN GRATE STOKER.

any slack which accumulates in the chain can be taken up by means of bolts at the front of the stoker, even while the stoker is in operation.



SIMPLEX TRAVELING GRATE STOKER, SIDE ELEVATION.

Not only can the feed of coal be regulated by change of driving speed, but by raising or lowering the feed gate the amount of coal fed can be varied. The commendable feature of this feed gate is that there is not a bolt in the entire feed gate frame to become rusted from the moisture in the coal. To put tile in place, all that is necessary is to slip the clip on the end of tile, hook the shoe on to the clip and hang the tile by means of the shoe on to the feed gate frame. The shoe and tile are then secured by a small tapered pin. It is evident that repairs to a feed gate of this type could easily be made, since all parts are accessible by merely dropping the hopper plate, which is held in place by a hook.

To efficiently and smokelessly burn coal on a chain grate stoker, there must be means for regulating the amount of air supplied to the furnace and a properly designed arch. To properly control the air supply, not only must the total amount of air passing through the furnace be subject to control, but the distribution of the proper amount to various areas of the grate for meeting various conditions must be in the hands of the operator. To meet these conditions, the ash baffle between the two strands of chain at the rear of the stoker have been devised. These prevent air leakage at places where excess air would be detrimental. The distribution of air to various portions of the grate is accomplished by means of movable dampers, and the great advantage of this arrangement is evident, especially in these days when a stoker is expected to perform its functions efficiently through a range of from 50 to 250 per cent. of its normal rating.

When doing half duty, enough dampers are closed to make the active grate surface just large enough to carry the load with the most economical rate of combustion of coal, and since efficiency is proportional to furnace temperature, it is evident that a short hot fire with no excess of air is far more efficient than a dead, smoldering fire carried to the end of the grate with cut stack draft, and rate of combustion per square foot of grate decreased to an unprofitable figure.

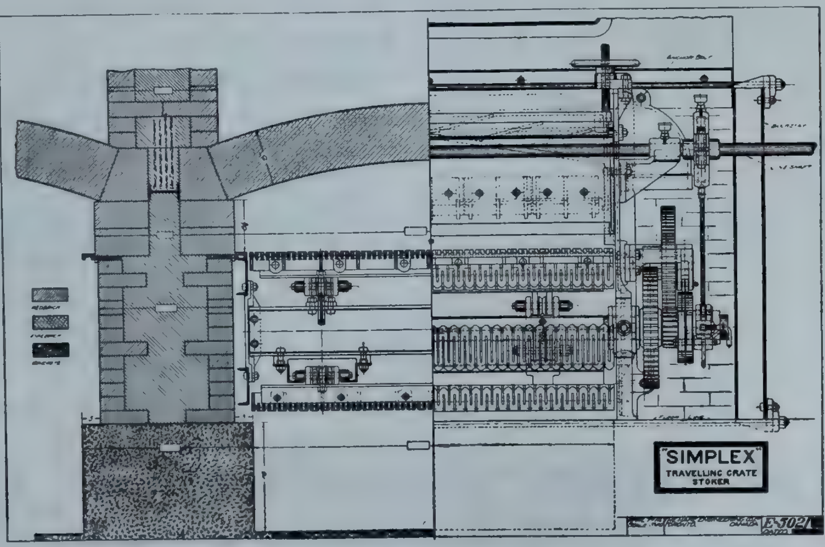
The design affords a large combustion chamber of practically uniform cross section its entire length. The short front arch precludes the possibility of the coal entering the furnace for a foot or more before igniting, while the arch, being high at the front of the setting, affords an opportunity for the flame to spread itself freely, thus raising the temperature of the short ignition arch and also reflecting the heat where it is required for raising, as soon as possible after entering the furnace, the temperature of the coal to its point of ignition. The arch construction is not only simple in its mechanical features, but in its detail is contributory to reliable and efficient service, while in the matter of replacement and repairs the arrangement is such as to facilitate these operations to the highest degree.

The foregoing apparatus is a product of the Illinois Stoker Co., Alton, Illinois.

SIMPLEX TRAVELING GRATE STOKER.

The Hare Engineering Co., Toronto, have recently brought out a new stoker of the traveling grate type which possesses a considerable number of interesting features. By the addition of this machine, they are now in a position to cover the entire field of mechanical stoking. It is generally conceded that no one type of stoker will handle all grades of coal to equal advantage; therefore, to secure the best possible results, the selection of the stoker must be made with due regard to the nature of the coal to be burned.

The Simplex Stoker is of the well-known traveling grate type, which has been so successful in Great Britain and the United States for many years. Chain grate and traveling grate stokers are to some extent similar as far as the method of firing is concerned. Both receive the fuel at one end of a moving fire-bed and discharge the ashes and refuse at the other. The differences are principally in the detail design and construction, and their influence on efficiency of operation. This stoker differs from the general run



SIMPLEX TRAVELING GRATE STOKER, FRONT ELEVATIONS.

of chain grates in a number of ways, among which may be mentioned the following:—

1. Sifting, owing to the fact that the grate bars have not the same relative motion as the links of a chain grate, is only a small percentage of that usually experienced with the other designs.

2. The upkeep on account of burnt and broken links is a minimum on a traveling grate stoker.

3. When repairs become necessary to a traveling grate, any bars may be removed and replaced without stopping the stoker.

It will be noted, by reference to the sectional cut, that the grate bars are bolted securely to structural steel tee bars extending from one link belt to the other. By employing this construction, the grate bars may crack or break entirely through in a number of places without affecting materially the service. In addition, two steel rods are cast in each grate, and these steel bars effectually hold the bars integral and independent of the steel tee bars to which they are bolted.

All parts of the Simplex stoker are remote from the influence of the heat of the fire, are of heavy structural steel beams instead of cast iron, thus making it capable of withstanding long and rough usage. A water-cooled fuel guard is fitted which effectually prevents undue loss of coke in the ash and requires no special attention. The water circulation in this fuel guard is based on the flash or positive action principle, and is the same as that employed with the Fulton water cooled stoker, and therefore is no new application of this efficient principle.

Another interesting feature of the Simplex stoker is that all the ashes are deposited at the front instead of at the rear. This relieves the fireman of the very arduous task of raking the ashes forward, and shovelling them out of a deep pit, as is the case when no underground ash tunnel is provided. This stoker, we understand, can be installed under any type boiler in service in a few days' time and with very little expense.

While all traveling and chain grate stokers do not necessarily give their best results when burning a caking or coking coal, they are nevertheless extensively used in burning such fuels on account of their simplicity of operation and minimum of attention required. The Simplex, with its water-cooled fuel guard and entirely self-cleaning feature, is an especially attractive stoker from this point of view. Again, as there is no necessity for it to be withdrawn from under the boiler to make repairs, it may frequently be installed in confined spaces. Without special care or attention this stoker operates practically smokelessly.

Engineers' Adjustable Wrench.—The Billings & Spencer Co., Hartford, Conn., have brought out an engineers' adjustable wrench, which is capable of being used wherever there is need for a solid end wrench, and in addition possesses the advantage of being adjustable for various sizes of nuts. The motion of the movable jaw is controlled by a worm meshing with a rack formed in the back of the jaw. The wrench is drop forged throughout and is made in four sizes, for handling $\frac{5}{8}$, 15-16, $1\frac{1}{8}$ and 1 5-16-in nuts.

◆

Suction Device.—A small magnet on a long handle is an excellent thing to have about a motor repair shop for lifting small nuts, bolts, etc., out of obscure places. It is open to the objection, however, that it will serve only for iron or steel articles. To overcome this objection there has just been placed upon the market a somewhat similar device in which suction takes the place of magnetism. The lifter consists of a rubber suction cups at the end of a handle, which is hollow and which is connected to the hose leading to an exhaust pump. A small thumb valve affords control, and there is a hook for dislodging small articles. The device is intended primarily to lift sheet metal stampings from under die presses, but it is useful in many other ways.

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S I E M E N S

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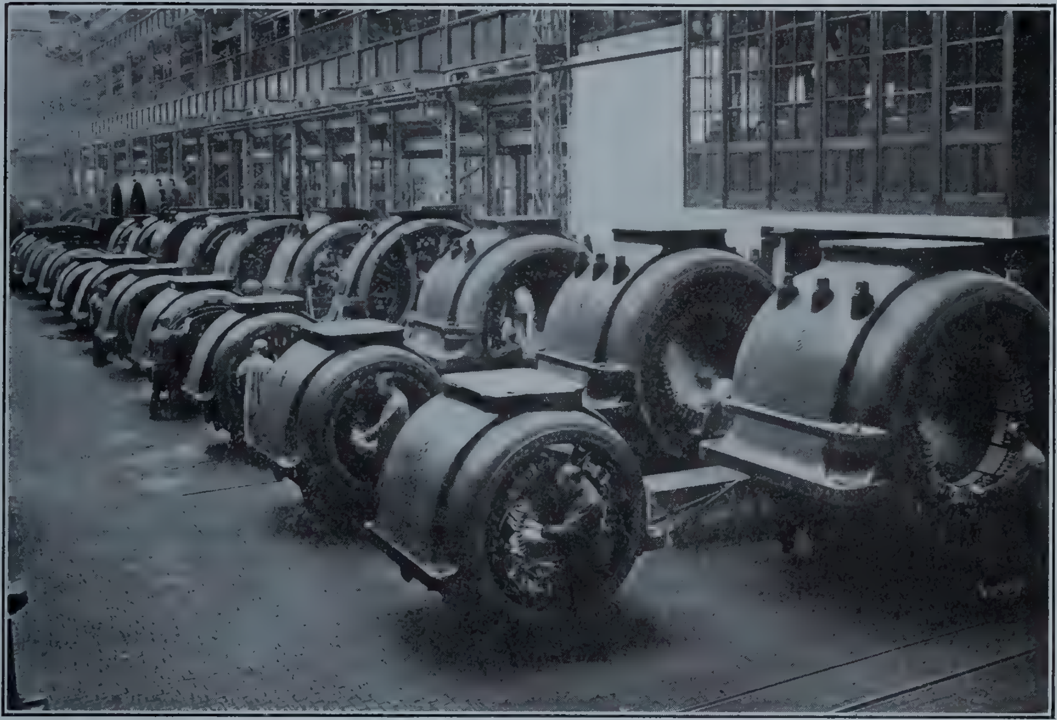

View in one of the Siemens Works showing Winding Department for Stators of Turbo Generator

The following Siemens **Turbo Generators** have been supplied or are on order for Canada:

1—4000 K.W. Edmonton.
1—3000 K.W. Regina.
1—2500 K.W. Dominion Coal Company.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Edmonton.
1—1500 K.W. Regina.
1—1500 K.W. Moose Jaw.
1—1500 K.W. Regina.
1—1200 K.W. Lethbridge.
1— 750 K.W. Nova Scotia Steel & Coal Company.
1— 675 K.W. Medicine Hat.
1— 675 K.W. Medicine Hat.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1—500 K.W. Wayagamack Pulp & Paper Company.

The Siemens Companies manufacture Turbo Generators in single units of 30,000 H.P.

Siemens Company of Canada Limited

HEAD OFFICE:

Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

Personal

C. J. Britton, manager of the Winnipeg branch of the Canadian Fairbanks-Morse Co., left last week on a trip to the Coast, for the purpose of observing conditions.

William R. Perrin died at his home in Chicago on June 2, aged 50. Mr. Perrin was the architect of the new municipal abattoir at Toronto, Ont., and was also president of the W. R. Perrin Co., Toronto, manufacturers of packing plant machinery and filter presses.

Charles G. Ritter, assistant superintendent of the Lunkenheimer Co., Cincinnati, Ohio, died at his residence in that city, May 23, after an illness of several months, aged 54 years. He had been with the company 22 years. In machine-tool circles he had an almost national reputation as a master tool maker. His brother Henry is superintendent of the Lunkenheimer Company.

Trade Gossip

E. Laurie Co., 240 Bleury St., Montreal, have been appointed agents of the Hare Engineering Co., for the Province of Quebec.

The Escher Wyss Co., Montreal, have been awarded the contract for one 1,400 h.p. water wheel, with governor, relief valve, blow-off valve and accessories, by the corporation of Revelstoke, B.C.

The Jones Underfeed Stoker Co., Ltd., Toronto, have been awarded a contract by the Standard Underground Cable Co., Hamilton, Ont., for four stokers to be installed with two 250-h.p. "Heine" water tube boilers.

The Turbine Equipment Co., Ltd., Toronto, have sold a 600-gallon per minute De Laval two-stage centrifugal pump, operating against a pressure of 100 lbs. to the Coniagas Reduction Co., St. Catharines, Ont.

The Escher Wyss & Co., Montreal, has been awarded a contract for a 6,000 k.w. turbo generator, by the Commissioners of Edmonton, Alta. The turbine is of the "Zoelly" Impulse type, and the alternator of Siemens make.

Victoria, B.C.—The City Council has approved of a report from the electric lighting committee and awarded a contract to the Canadian General Electric Co. of Toronto for two primary and one secondary transformer, at a total cost of $520.

The Turbine Equipment Co., Ltd., Toronto, Ont., has been awarded a contract for a De Laval centrifugal pump by the City of Stratford, Ont. The pump will have a capacity of 1,000 gallons per minute against a head of 200 feet.

The Escher Wyss Co., Montreal, has been awarded a contract for one steam turbine driven centrifugal pump of 200 h. p. capacity, 1,500 r.p.m. by the B.C. Government, through Frank Darling & Co., Vancouver, their agents in British Columbia.

New Toronto, Ont. — Tenders were received up till June 12 for the supply and laying of cast-iron water mains, valves, hydrants, etc., and steel water tank; also for the supply of steel intake pipe. Plans and specifications may be obtained from James Loudon & Hertzberg, engineers, Toronto, Ont.

The Turbine Equipment Co., Ltd., Toronto, has sold to the Union Carbide Co., Welland, Ont., the following equipment: One 1,500 gallons per minute De Laval single stage centrifugal pump to operate against a pressure of 100 lbs., also one 850 gallons per minute De Laval single stage centrifugal pump to operate against a pressure of 75 lbs. Both these pumps will be motor driven.

Regina, Sask.—Contracts have been awarded as follows: cast-iron pipe, Canada Iron Corporation, $60,165; lead pipe, Jenkins & Hardy, $6,100; galvanized iron pipe and jute rope, Metals, Ltd., $946.40; pig lead, J. H. Ashdown Co., Ltd., $6,986; gate valves and hydrants, Drummond, McCall & Co., $8,204; 2-inch brass gate valves, Metals, Ltd., $110; brass goods, Mueller Mfg. Co., $4,040.

Wallaceburg, Ont. — The following contracts have been awarded in connection with the waterworks system: Pump house, McGregor & Rankin; water tower and foundation, Hunter Bridge & Boiler Co.; cast-iron pipe, National Iron-works; fire hydrants, Canadian Allis-Chalmers, Ltd.; valves, Drummond, McCall Co.; water filters, American Water Softener Co.; pumping machinery, Canadian Fairbanks Morse Co.; intake and basin, A. Thrasher Contracting Co.

Montreal, Que. — The contract has been awarded to the Mannesmann Tube Co., of Montreal, for the supply of steel and cast-iron pipe and specials for Swift Current at a cost of $7,566.75; for hydrants, gate valves and boxes, to Rensselaer Valve Co., of Troy, N.Y., at $1,741.25; for sewer and water construction, to M. S. Holmes, Souris, Man., at $32,101.48; for sewer pipe and specials, to Vitrified Clays Co., Calgary, Alta., at $7,535.37.

Canadian Electrical Association Convention.—The annual convention of the Canadian Electrical Association will be held this year in Montreal on June 24, 25 and 26. The headquarters of the convention will be in the new club rooms of the Canadian Society of Civil Engineers, Mansfield street. At a recent meeting of the executive branch, committees were formed including a convention committee of Montreal men, a committee in Toronto to co-operate with them, a papers committee, etc.

Winnipeg, Man.—The contract for the economizer and induced draft plant for the power house of the new law court building has been awarded to J. A. McTaggart & Co., at the sum of $23,000. This firm was also successful in securing the contract for the ventilating apparatus of the law courts building, they representing the B. F. Sturtevant Co. of Galt, Ont., and manufacturing in Winnipeg, the Acme air washers which are being installed.

Toronto, Ont.—The tender of the John ver Mehr Co., of this city, to construct a Ransome drifting sand filter of 60,000,000 gallons a day capacity at the Island, has been accepted by the city council, with a vote of 15 to 1, on June 9. The filtration plant is to cost $1,066,282, and is guaranteed with a cash bond of $250,000 to produce tasteless, colorless water, 98 per cent. bacteriologically pure, and to require not more than one grain of chemical per gallon for the treatment.

Sidney, N.S.—An effort is being made to establish here a cold storage plant of two hundred tons capacity, and, in that connection, the Department of Agriculture at Ottawa, has been approached with a view to obtaining the usual subsidy amounting to thirty per cent. of the cost. The chief object of the proposed industry is the storing of fresh fish and to make possible the introduction of canning plants at this place. Excellent sites are available at reasonable prices.

Cedars Rapids Mfg. and Power Co.—The substantial progress accomplished in the ten-million-dollar water-power development at Cedars Rapids, near Montreal, was revealed to an interested party which made a visit of inspection to the new plant on Saturday, May 16, as guests of the directors of the Cedars Rapids Manufacturing and Power Co. In respect both to speed of construction and to cost, the undertaking gives fair promise to prove a record-breaker among local enterprises of like magnitude by justifying the advance estimates of the company. In important directions the work is now three-quarters completed, the company being well within the carefully-drawn-up schedule, which was mapped out some two years ago. Barring some unforeseen and very improbable setback through the summer, the plant will be developing by November 1, the 100,000-horse-power planned as the initial installation.

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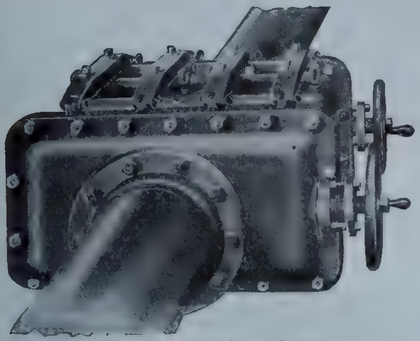
The only DIRECT FLOW Strainer built that gives contiuuous service.



Horizontal position, doors on top.

Do your condenser tubes become clogged with rubbish?

Do your pump valves get stopped up, cut out, need constant attention?

Do you have trouble with any of your water handling machinery, on account of the leaves, sticks, grass, etc., in your service water?

The TWIN STRAINER is the best remedy for such troubles. The thousands of them in use to-day is the best evidence we have of their satisfactory service.

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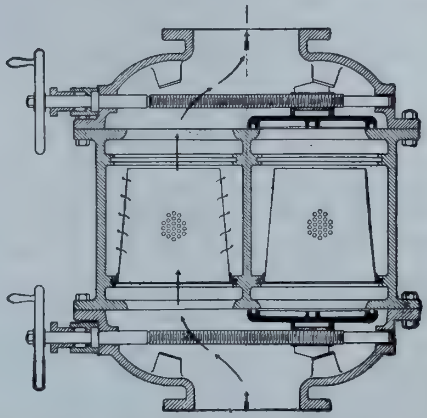

Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

An Expert's Opinion

The following is an extract from a letter recently written in answer to a request for expert information relating to boiler tube cleaning:

"Your valued letter of the 4th received, enclosing letter from the Liberty Company, manufacturers of Turbine Tube Cleaners. I have carefully read their letter, and I congratulate you on having gone to a party who is conservative, and the longest in the business of any manufacturer of mechanical Tube Cleaners for water tube boilers."

This letter was written by the head of a Company who are recognized as authority in all matters pertaining to the constructing and operating of all types of steam boilers. We obtained the letter from a correspondent, and are not at liberty to use their name. When such men recognize the **superiority of Liberty Cleaners**, you are certainly taking **no risk** in allowing us to send you one of our Cleaners on trial.

Write for additional information, and free trial offer.

Liberty Manufacturing Company

6904 Susquehanna Street PITTSBURGH, PA.

Canadian Representatives:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

Catalogues

Lubricators. — The Detroit "300" grease lubricator is described fully in a leaflet being distributed by the Detroit Lubricator Co., Detroit, Mich. The principal features of this lubricator are set forth and accompanied by illustrations.

Oil Purifiers.—"How to Purify Transformer and Switch Oils Economically" is the title of bulletin No. 87, recently published by the Elliott Co., Pittsburgh, Pa. The "Elliott" capillary filter, designed for the above purpose, is described in detail, accompanied by a sectional view showing the construction. Copies may be obtained by writing the company.

Mesta Rope Drives is the subject of bulletin "O" mailed by the Mesta Machine Co., Pittsburg, Pa. The bulletin contains considerable matter dealing with the advantages of rope drives and valuable information on the life of Manila ropes. The illustrations include views of several installations, large rope sheaves and a typical mill layout.

Mechanical Draft is the title of catalogue No. 22, recently published by Sheldon's, Ltd., Galt, Ont. Mechanical draft is dealt with in all its phases, as are also the relative merits of forced and induced draft. The various types of equipment which the company make are illustrated and briefly described. The catalogue contains some interesting data on fan capacities and water pressure.

Boiler Cleaning Logic.—A pamphlet devoted to the treatment of external surfaces of steam boilers and published by the Bayer Steam Soot Blower Co., St. Louis, Mo., has reached us. The "Bayer" soot blower system is described fully and its application clearly shown by means of a number of illustrations. The pamphlet also contains several copies of testimonials and partial list of users.

Motors and Generators made by the Lincoln Electric Co., Cleveland, Ohio, are dealt with in three bulletins which have come to hand. The constructional features of the machines are described in detail with illustrations of the various parts of the type"F" motors and type "M" generators. One bulletin contains numerous illustrations showing views of installations, indicating the wide range of service possible with these machines.

Storage Batteries for Electric Lighting Plants.—The Canadian General Electric Co., Toronto, have published a book of information about the above which will be useful to those interested in such equipment. The booklet contains a deal of information concerning the "Hyray" battery and the "Chloride Accumulator," both made by the Electric Storage Battery Co., Philadelphia, Pa. The booklet is fully illustrated.

Reducing Valve and Pump Governor.—Bulletin No. 9, issued by the C. A. Dunham Co., Toronto, deals with the "Fisher" reducing pressure valve and vacuum pump governor. A comprehensive description is given of these fittings, with tables giving the weight, price and code word for each size. Diagrams are included for each fitting, with the name of each part given, while one table gives the principal dimensions for each size of pressure-reducing valve.

The Bayer Feed Water Purifier is treated at length in an attractive bulletin sent to us by the Bayer Steam Soot Blower Co., St. Louis, Mo. The feed water problem is discussed and the claims for the "Bayer" purifier set forth, followed by a complete description of this apparatus. One page is devoted to boiler troubles, their causes and remedies. Tables of evaporation and coal consumption are also included. The bulletin is fully illustrated to show the application of the "Bayer" purifier.

Watthour Meters.—The Canadian Westinghouse Co., Ltd., Hamilton, Ont., have sent us a bulletin, No. 1137, descriptive of their Watthour meters for alternating and direct current. The principles of construction and operation are dealt with fully, while considerable space is devoted to a description of the type C meter. A feature of the bulletin is the arrangement of the illustrations, several of which show very distinctly the constructional details of the meters, the name of each part being indicated by means of arrows.

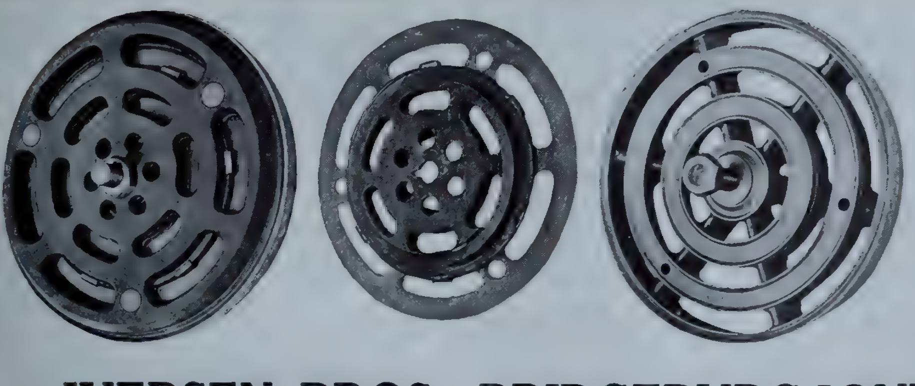
Turbine Governor.—We have received from Mr. Percy H. Pitman, a reprint of an interesting paper on an improved governor for water turbines, which was read before the Institution of Mechanical Engineers, London, England. The governor is, of course fully described in this paper, and the claims made on its behalf discussed in detail, the principal one being that it gives a most perfect speed regulation. The governor is made by Mr. Pitman at his works, Acton, near London, England, where water turbines are also made.

Generating sets, made by the Enberg's Electric and Mechanical Works, St. Joseph, Mich., are described fully in bulletin No. 24 recently issued by the company. The "Enberg" generating sets are made in sizes from 2½ to 50 kilowatt, and two tables are included giving the weights and principal dimensions for each. The illustrations show the principal features embodied in the construction of engine and generator. Copies of this bulletin may be obtained from the Canadian agents, the A. R. Williams Machinery Co., Toronto, Ont.

Feed Water Meters.—The Canadian Allis-Chalmers, Ltd., Toronto, have sent us a very attractive catalogue descriptive of the "Cochrane" feed water meters made by the Harrison Safety Boiler Works, Philadelphia, Pa. The advisability of metering feed water and various methods employed are dealt with at length. A full description is given of the "Cochrane" metering heater, covering the design and construction, accompanied by numerous illustrations of various types, including installations. A list of users is given while the concluding pages contain much useful information relative to steam boiler economy, properties of saturated steam, boiler heat balance, etc.

Turbine Pumps.—Canadian Allis-Chalmers, Ltd., Toronto, have just issued an exceptionally interesting bulletin, No. 2001, dealing with the Mather & Platt type of turbine pumps which they make. A feature of the bulletin is the description of the pump testing plant at Rockfield, Que. The methods adopted in conducting the tests and description of the plant are given in detail, accompanied by illustrations. A full description is given of the Mather & Platt pump with cross sections showing the principal features of the design, and exterior views of several types, including many illustrations. The concluding pages contain much useful data on pipe friction and several characteristic curves for high-lift pumps.

Mechanical Power Transmission Machinery is the title of a very complete catalogue issued by Canadian Allis-Chalmers Ltd., Toronto. That power transmission covers a wide field and calls for many and varied types of equipment is amply demonstrated in this catalogue. Illustrations and descriptive matter of practically everything relating to transmission machinery, too numerous to mention in detail, are contained in this catalogue. The tables of dimensions and other data accompanying each item are sufficiently complete for the use of purchasing agents and others. The catalogue contains a number of mechanical tabels and similar data, all useful for transmission calculations. The illustrations are very clear and the reading matter well arranged and comprehensive. The catalogue contains a complete index and is well bound in attractive cloth covers.



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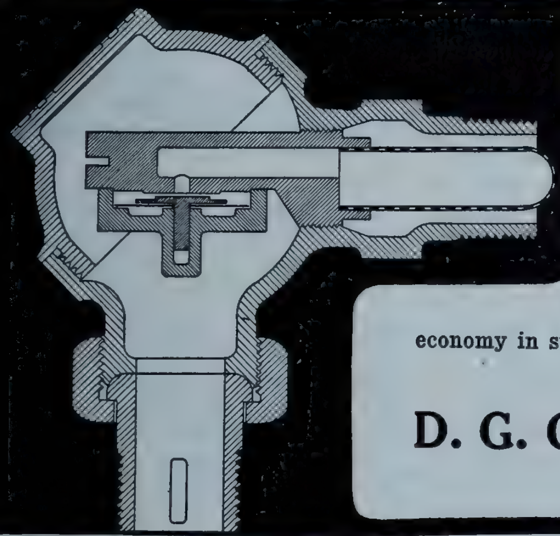

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are distinctively different. They have no springs, no floats, no counterweights, no thermostatic plugs, no regulating screws, and **never require adjustment.**

Absolutely fool-proof, and cannot get out of order.

They guarantee a perfectly regulated heating system with economy in steam, and no back pressure on the engines.

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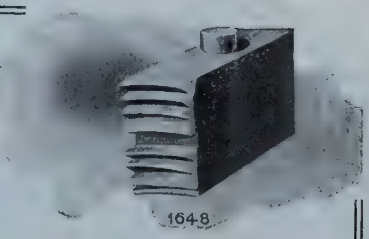
Boiler Graphite

The action of Dixon's Flake Boiler Graphite is to soften and break up the scale already in a boiler, and then to coat tubes and sheets with a film of graphite to which scale cannot adhere. In doing this, no form of graphite is so effective as the flake form—and there is no flake graphite superior to Dixon's Ticonderoga Flake. Study the question in "Graphite For The Boiler," No. 222, free.

Made in Jersey City, N.J., by the
JOSEPH DIXON CRUCIBLE CO.
Established 1827.

"PREMIER" Die Stocks

have a new Patent Off-Set Die which does away with leader screws and much trouble.



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With one set of dies you can thread pipe 1 to 2 inches right, and 1 to 2 inches left. The Off-Set Die enables you to accomplish, by going over the pipe once, what any other make would do in going over it twice, and **it does away with leader screws, and nuts—and much trouble.**

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No loose bushings to carry around or lose.

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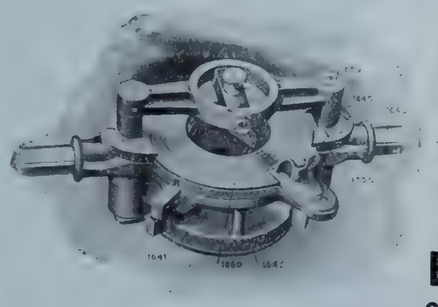
Drop a card for full particulars.



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Book Reviews

Hydraulics, by Ernest H. Sprague, A. M.I.C.E., 184 pages, $4\frac{1}{2}$ x 7 inches, 89 illustrations and several tables. Published by Scott, Greenwood & Son, London, England. Price 3/6, (.84) net. This is a new work on hydraulics, being the tenth volume of the "Broadway Series of Engineering Text-Books." It has been written as a text-book for students and engineers, and compiled chiefly from the lecture notes of the author, who is assistant professor of engineering at the University College, London, England. In this volume the author has treated the subject in a comprehensive manner, and has not gone too deeply into the theory of hydraulics, although when dealing with a subject of this kind, mathematics necessarily assume considerable importance in the solution of the various problems. The calculus has been used freely for, as the author says, the necessity of the case is sufficient reason for its employment. It has been assumed that the student will have a good knowledge of mathematics and so should not have much difficulty in understanding the formulae and examples, as the latter have been worked out in full, each step being printed in clear type. These examples form an important feature of the book and enable the student to obtain a better grasp of the subjects than would otherwise be the case. In addition to the series of examples given with each subject, there are five pages devoted to miscellaneous examples, not worked out, although the answers are given. The book contains six chapters dealing with such subjects as the principles of fluid pressure, liquids in motion, discharge through orifices, weirs, etc., flow in pipes and channels, pressure of water and application to motors; the last chapter being devoted to pumps and the hydraulic ram. The book is fully illustrated and has at the end, a number of mathematical tables, and some useful data on hydraulics.

The D'Este Steam Engineers' Manual, with Electrical Appendix by Charles Penrose, 448 pages, $4\frac{1}{2}$ x 7 in., 240 illustrations, with four plates. Full leather binding gilt edges. Published by the Julian D'Este Company, Boston, Mass. Price $2. This is an exceedingly useful handbook for practical power plant engineers, covering both the mechanical and electrical ends. The book is arranged in two parts, the first containing 138 pages and dealing with the mechanical side, while the second part called the Electrical Appendix and written by Charles Penrose, contains 351 pages, and is devoted to the practical end of electrical engineering. In the first part the steam plant engineer, are dealt with briefly. Succeeding chapters are devoted to the theory of steam, care of steam boilers, evaporative tests, pump data, strength of and power transmission by shafting, strength of riveted points and boiler shells, etc. Descriptions of plant equipment are given, covering mechanical stokers, measurement of mechanical energy, belting, and the steam engine indicator, while other chapters deal with valve setting, mechanical refrigeration, etc., and conclude with a number of mathematical tables. The introductory chapters of the second part are devoted to a discussion of electrical units, electrical measurement and the fundamental features of the operation of dynamo electrical machinery. Later chapters deal with temperature measurement by electrical means, photometry and a synopsis of present day electrical equipment of alternating current generating stations. In connection with this chapter there is an interesting folding chart showing the layout of the equipment employed and the relation between the various units. Other chapters contain illustrations of modern generating sets, high tension equipment and distributing switchboards. The three other folding charts show respectively the layout of a steam plant and the connection between the various units employed; sectional view of a steam electric generating station, and a connection diagram of a typical hydro-electric generating station. The book contains a large number of illustrations and diagrams, the reading matter is clear and well arranged, and the covers are attractive, being of leather.

Arithmetic of the Steam Boiler, by Charles J. Mason; 219 pages, $6\frac{3}{4}$ x $4\frac{1}{4}$ in.; illustrations, tables and diagrams, published by McGraw-Hill Book Co., New York. Price $1 net. This is the first edition of a work which has been included in the series of "Power Handbooks." It is a compilation of arithmetical rules and formulae, applicable to steam boilers of various types. The book deals with the application of arithmetic to steam boiler calculations, it being assumed that the reader is more or less familiar with the elements of arithmetic and understands the working of simple problems. The volume is divided into three parts. The first is sub-divided into chapters, the second is devoted to miscellaneous applications, while the third contains an appendix and a number of tables. The first chapter covers calculations on cylindrical vessels, as applied to boilers, also those for riveted joints. Boiler heads, stayed and unstayed, are dealt with in chapter 2, while chapter 3 is devoted to calculations for tubes, furnaces and boiler horse-power. In this chapter there is also an analysis of a boiler trial report. In part 2 a number of interesting calcu-

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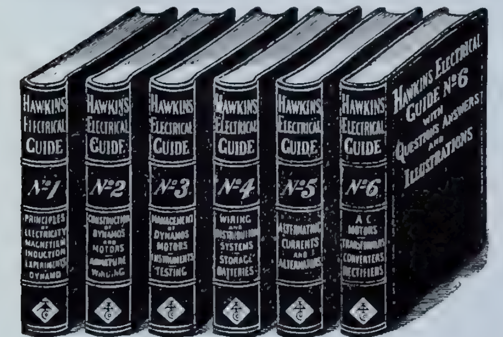
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Walker's Electric Boiler Compound will keep scale from forming if used regularly. It will not injure your boilers, fittings or pumps —it will keep your boiler at full capacity, thereby maintaining efficiency—it will prevent pitting or corrosion or other boiler troubles, due to impurities in your feed water.

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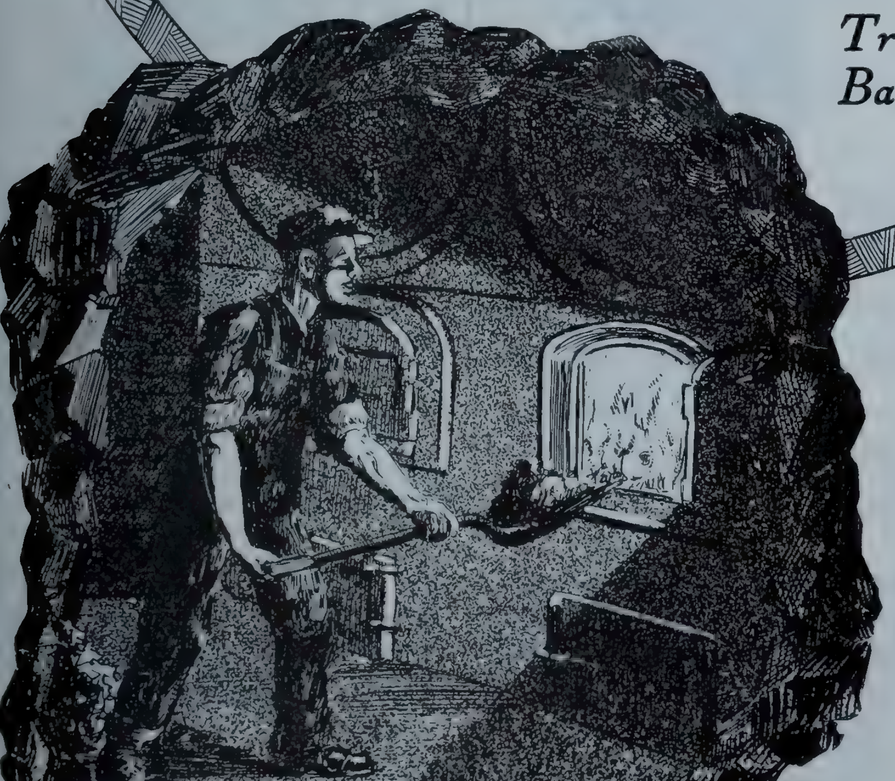

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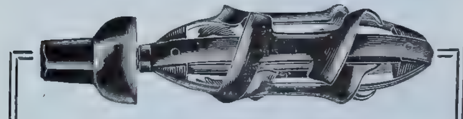

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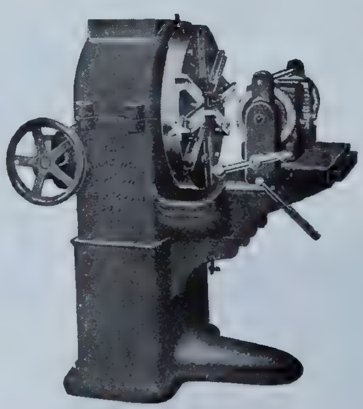

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lations are given covering the strength of various parts, including formulae on safe working pressures. Part 3, or appendix, contains extracts from the rules of the United States Board of Supervising Inspectors, and from the rules of the State of Massachusetts for the design of boilers. The concluding pages contain mathematical tables, factors of evaporation, steam tables, etc. This will be found an exceedingly useful book for students and power plant engineers, and especially so for those who are preparing for examination for engineers' certificates. The author treats the subjct in a practical manner, and has carefully avoided complex calculations; as a result, readers will find no difficulty in applying the data contained in the book to the solution of problems arising during the performance of their duties.

Heat.—By E. M. Shealy, 262 pages, 6 x 9 inches, 110 illustrations, cloth. Published by the McGraw-Hill Book Co., New York. Price $2 net. This book is one of a series prepared by the Extension Division of the University of Wisconsin, and deals with the application of heat to various types of machinery, such as steam and gas engines, air compressors and refrigeration plants. The text is designed to supply the fundamental knowledge necessary for the successful study and understanding of this class of machinery and may also be regarded as a foundation for advanced studies, treated as separate courses. The first part of the text treats of the fundamental laws relating to the nature, generation, and transportation of heat and presents familiar examples of practical applications. The expansion and compression of gases and the nature and properties of steam, ammonia and carbon di-oxide, etc., are taken up. In the latter part of the book the principles of the steam engine, gas engine, refrigerating machine, and air compressor are treated, and the relation of the laws of heat to these units is shown. The first six chapters deal with temperature, work and power, energy, transferring, generation and measurement of heat. Then follow chapters dealing with compression and expansion of gases, properties of steam, condensation and evaporation. Chapters 11 to 15 are devoted to steam and gas engines, air compressors and refrigeration, while the last chapter deals with various methods of heating buildings. A number of very useful tables are given which will be helpful to the student, while the illustrations are clean cut and descriptive. At the end of each chapter is a series of questions which should materially assist also in obtaining a clear understanding of the text. The author, is assistant professor of steam engineering at the University of Winconsin.

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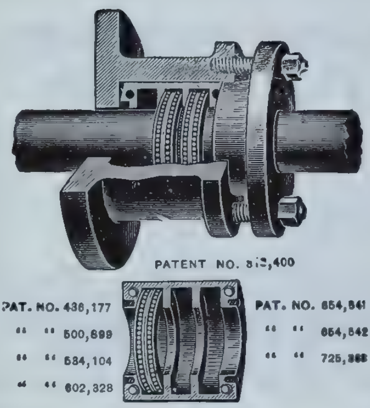

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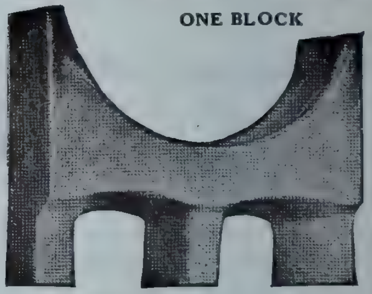

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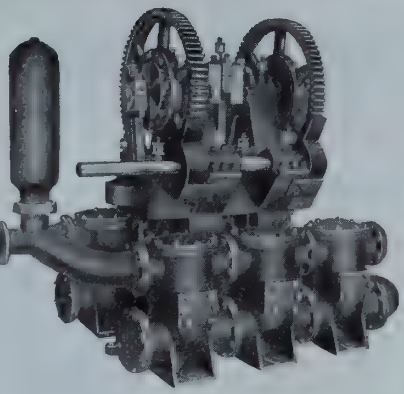

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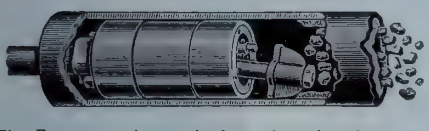
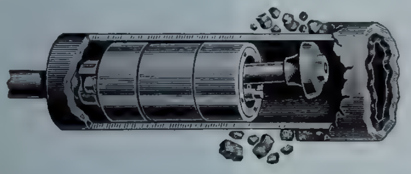


The Dean removing scale from the tube of a water-tube boiler.



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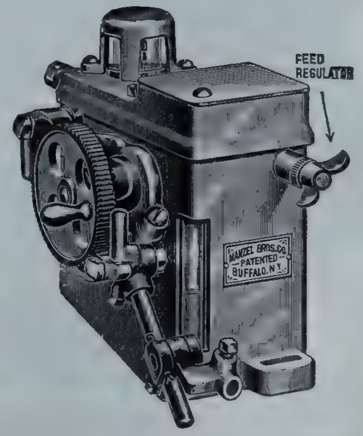
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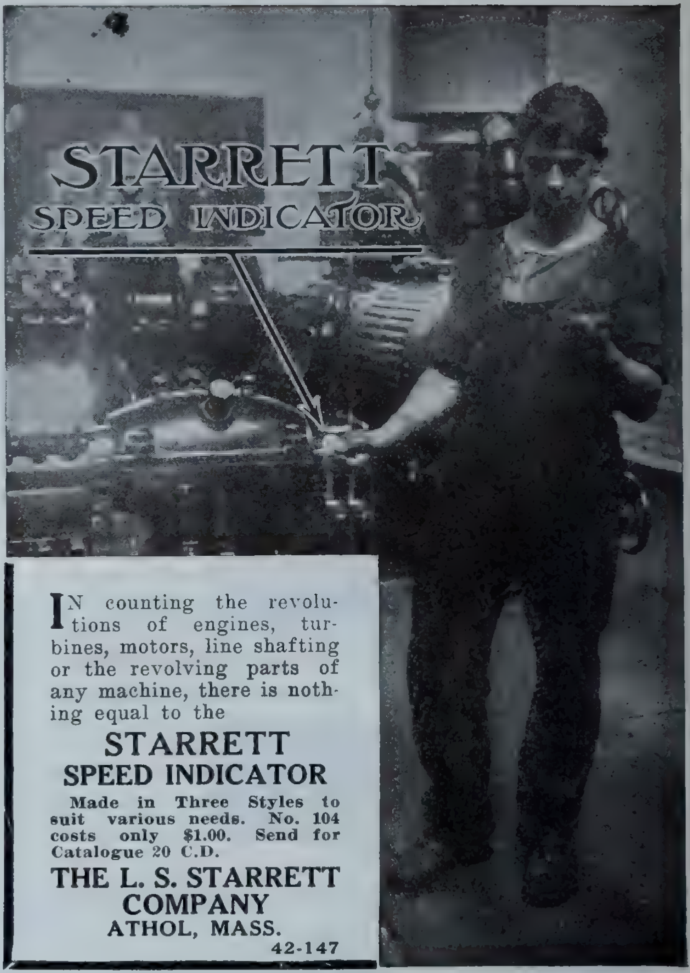

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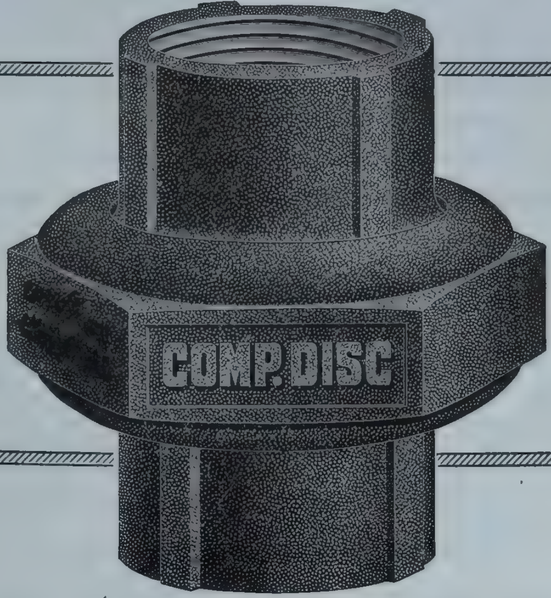

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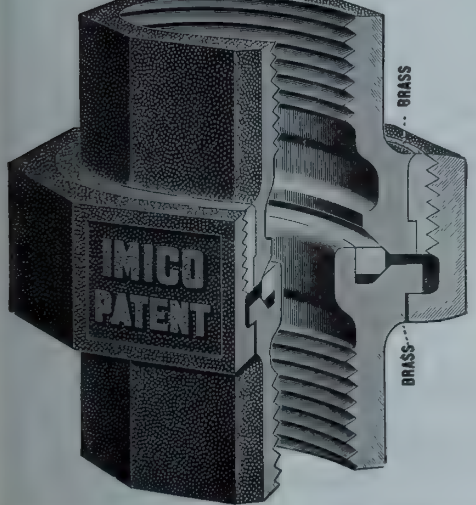

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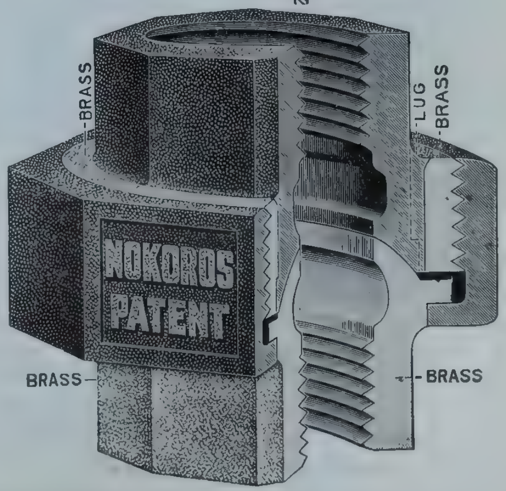

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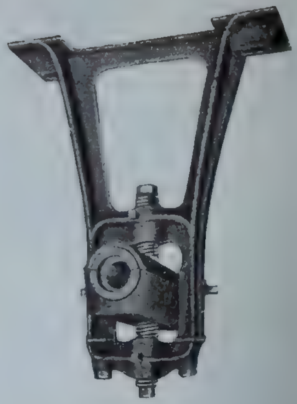

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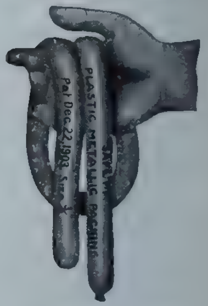

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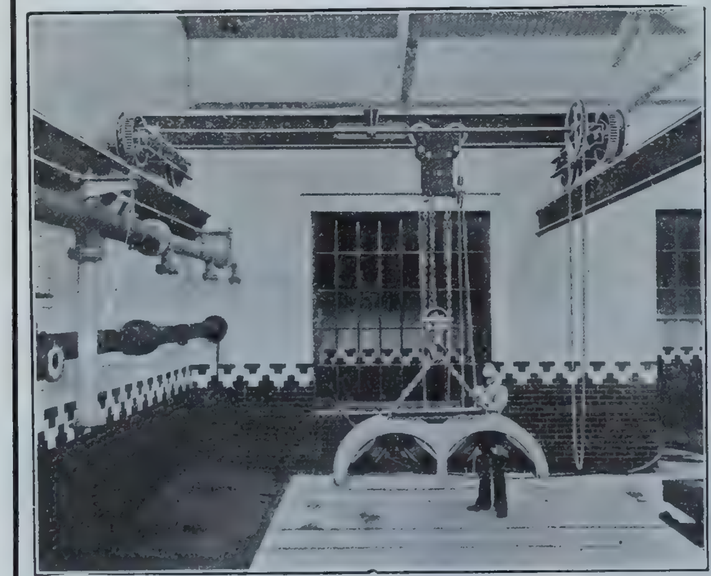

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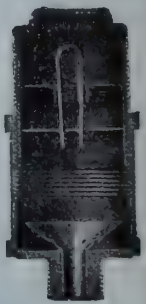

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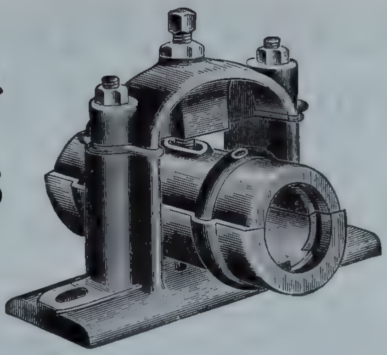

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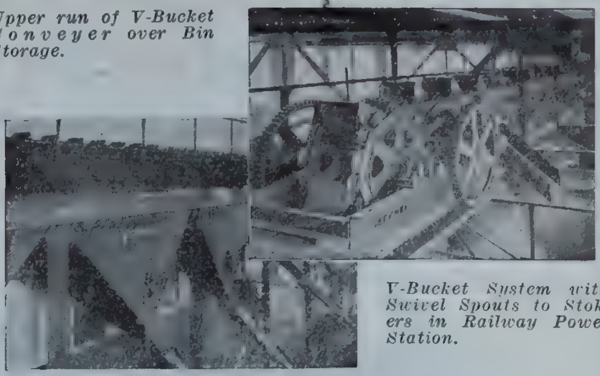

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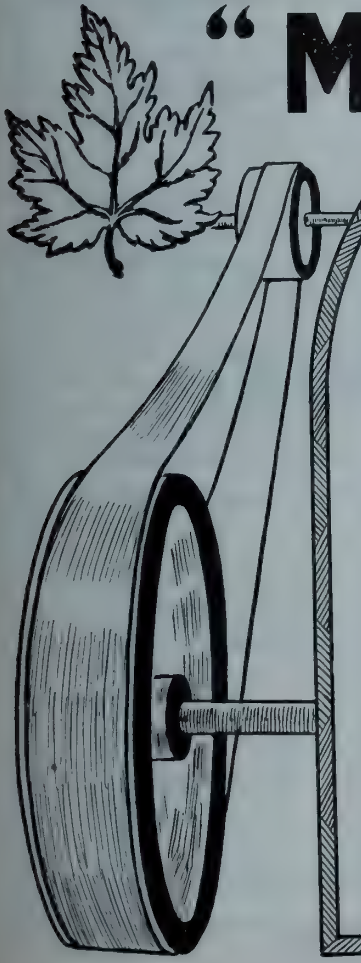

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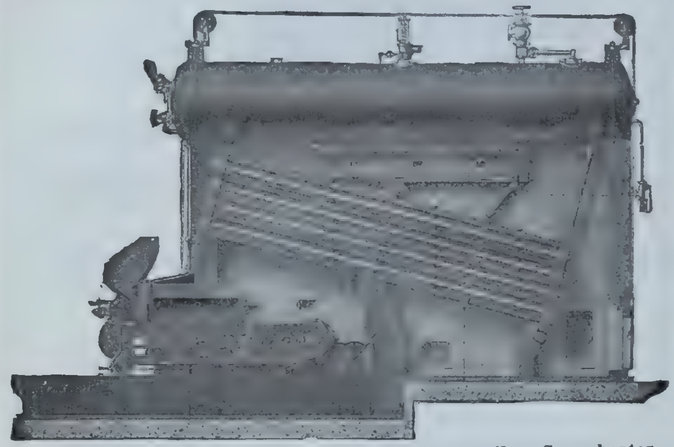

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F. Reddaway & Co., Montreal.

Belting, Stitched Cotton Duck.
F. H. Andrews & Son, Quebec.
Can. British Eng. Co., Winnipeg.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Dominion Belting Co., Hamilton, Ont

Belting, Leather.
F. H. Andrews & Son, Quebec.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Garlock Packing Co., Hamilton, Ont.
D. K. McLaren, Ltd., Montreal.
Graton & Knight Mfg. Co., Montreal.

Belting, Rubber.
Canadian Consolidated Rubber Co., Montreal.
F. H. Andrews & Son, Quebec.
Can. British Eng. Co., Winnipeg.
Jeffrey Manufacturing Co., Columbus, Pa.
Quaker City Rub. Co., Philadelphia,

Beltings, all kinds.
Reddaway & Co., F., Montreal.

Bending, Pipe.
National Pipe Bending Co., New Haven, Conn.

Bins, Coal, Coke and Ore.
C. W. Hunt Co., New York.
Jeffrey Manufacturing Co., Columbus.

Blocks, Lifting.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Blowers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
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Boiler Arches and Setting.
Betson Plastic Fire Brick Co., Rome, N.Y.
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Can. Supply & Contracting Co., Toronto.
Can. Oil Companies, Ltd., Toronto.
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Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dearborn Chemical Co. of Canada, Toronto.
Electric Boiler Compound Co., Guelph, Ont.
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Boiler Compound Feeders
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Lunkenheimer Co., Cincinnati, O.
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Boiler Feed Pumps.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
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Boiler Tube Cleaners.
Bader & Halbig, Hallea, Salle, Germany.
Bromell Patents Co., Ltd., Glasgow, Scotland.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
Wm. B. Pierce Co., Buffalo, N.Y.
S. I. Thomas, Toronto.

Boilers, Horizontal, Return, Tubular and Watertube.
Alex. McKay Boiler Works, Montreal.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Frick Co., Waynesboro, Franklin Co.,
Hamilton Co., Wm., Peterborough.
John Inglis Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que
Jones Underfeed Stoker Co., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Polson Iron Works, Toronto.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Wks. Co., Brantford

Boilers, Marine, Locomotive and Vertical.
Alex. McKay Boiler Works, Montreal.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Polson Iron Works, Toronto.
International Engineering Works, Ltd., Amherst, N. S.
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Brine Coolers.
Frick Co., Waynesboro, Franklin Co., Pa.

Brine Tanks.
Frick Co., Waynesboro, Franklin Co., Pa.

Cables, Aerial and Underground.
Can. British Eng. Co., Winnipeg.
Eugene F. Phillips Electrical Works, Ltd., Montreal.
Northern Electric Co., Ltd., Montreal.

Calorimeters.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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Jas. Morrison Brass Mfg. Co., Toronto.

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American Pulley Co., Philadelphia.

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Commercial Oil Co., Hamilton.

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Lunkenheimer Co., Cincinnati, O.

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John Inglis Co., Ltd., Toronto.

Cast Plate Track
C. W. Hunt Co., New York.
Orenstein-Arthur Koppel Co., Pittsburg.

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John Inglis Co., Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.
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Cement, Fireproof.
Betson Plastic Fire Brick Co., Rome, N.Y
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.

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Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Chain Drives.
Morse Chain Co., Ithaca, N.Y.

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C. W. Hunt Co., New York.
Orenstein-Arthur Koppel Co., Pittsburg.

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Dearborn Chemical Co., Chicago.
C. C. Snowdon, Calgary.

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Engineering Works of Canada, Ltd., Montreal.
Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

Coal.
Dom. Coal Co., Montreal.
Ohio & Michigan Coal Co., Detroit,

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Elmira Machinery and Transmission Co., Elmira.
Waterous Engine Wks. Co., Brantford

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Babcock & Wilcox. Montreal.
C. O. Bartlett & Snow Co. of Canada, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Geo. H. Tod, Toronto.
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Ed. Bennis & Co., Little Hulton, Bolton, Eng.
C. W. Hunt Co., New York.
Geo. H. Tod, Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.

Coils.
Frick Co., Waynesboro, Franklin Co., Pa.

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Can. Bond Hanger & Coupling Co., Alexandria, Ont.

Cold Storage Insulation.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Robinson Bros. Cork Co., Toronto.
Kent Co., Montreal.

Condensers.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
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John McDougall Caledonian Iron Wks, Montreal.
Waterous Engine Wks. Co., Brantford
Arctic Ice Machine Co., Canton, Ohio.

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Frick Co., Waynesboro, Franklin Co. Pa.

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Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
G. M. Davis Regulator Co., Chicago.

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Can. British Eng. Co., Winnipeg.
E. Leonard & Sons, London, Ont.
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John T. Farmer, Montreal.
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Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.

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Babcock & Wilcox, Montreal.
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Canadian General Electric Co., Ltd., Toronto.
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Theodore Kipp Co., Winnipeg.
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Commercial Oil Co., Hamilton.

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Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

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Boving & Co., of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
John Inglis Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
International Engineering Works, Ltd., Amherst, N. S.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

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Laurie & Lamb, Montreal.
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Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
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Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
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Boving & Co., of Canada, Limited, Toronto.
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Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Kerr Engine Co., Walkerville.
International Engineering Works, Ltd., Amherst, N. S.
Waterous Engine Works Co., Brant-

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Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst. N. S.

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Lunkenheimer Co., Cincinnati, O.

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Griscom-Russell Co., New York.
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Canadian Steam Boiler Equipment Co., Toronto.
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Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
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National Pipe Bending Co., New Haven, Conn.
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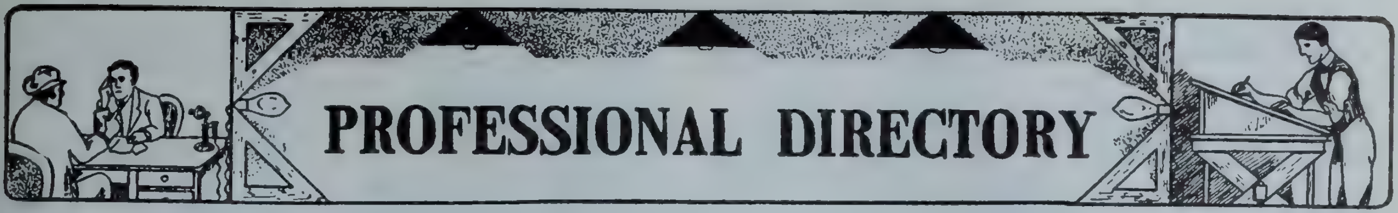

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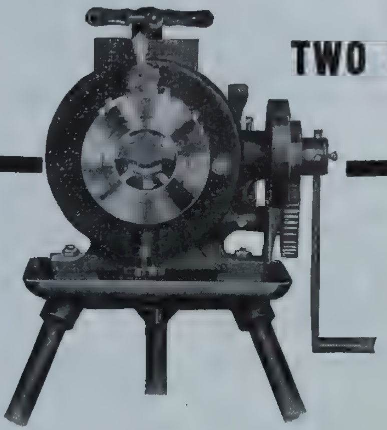

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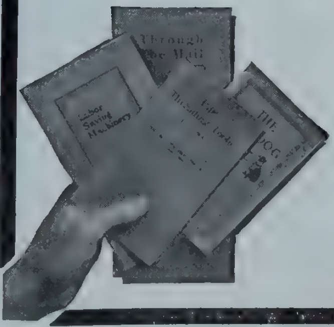

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The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Wks. Co. Brantford

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No. 2 Regulator with oil dash pot

Made with screwed or flanged ends, standard or extra heavy.

Fit the steam pressure to the job

WHEN your boiler pressure is too high for certain jobs or so low that it slows up others, you lose money in two ways—in the extra coal burned trying to maintain a given pressure and in steam unnecessarily wasted on machines whose required operating pressure is far below boiler pressure. Why not prevent these losses—automatically fit the steam pressure to the job with

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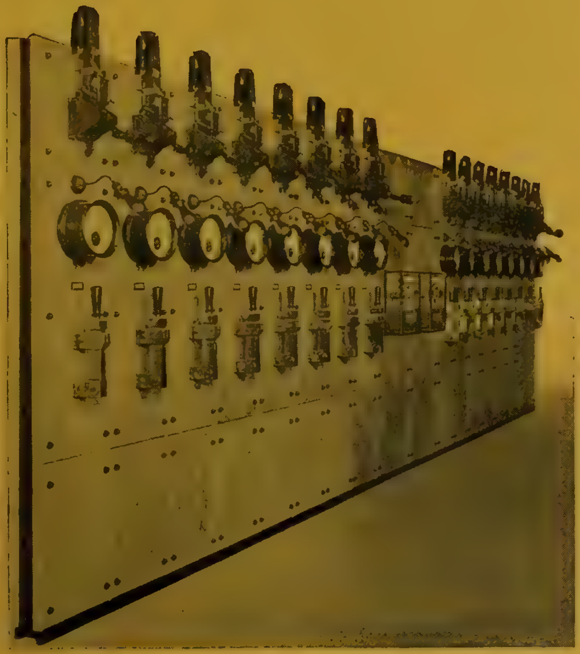

These are good illustrations of the symmetrical and attractive appearance, both front and rear, of

Westinghouse Switchboards

THIS board was built for an electric railway and controls sixteen 1600 ampere, 550 volt feeders.

Attention is invited to the compact and pleasing arrangement of the Westinghouse Type CA Carbon Breakers along the top of the board, and to the neat and clean-cut lay-out of bus bar and copper connections in the rear.

Safety of the operator and attendants is given first consideration in the design and equipment of Westinghouse Switchboards. They are designed, assembled and built complete by our own experts in our own works.

We build switchboards for every purpose,
of any size from one panel upwards.

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PERFECTION

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James Morrison, Toronto

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The Guarantee TRADE J.M.T. MARK REGISTERED *of Quality*

The James Morrison Brass Mfg. Company, Limited

93-97 Adelaide St. West **Toronto, Canada**

Special Feature---News of Coming Convention

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.
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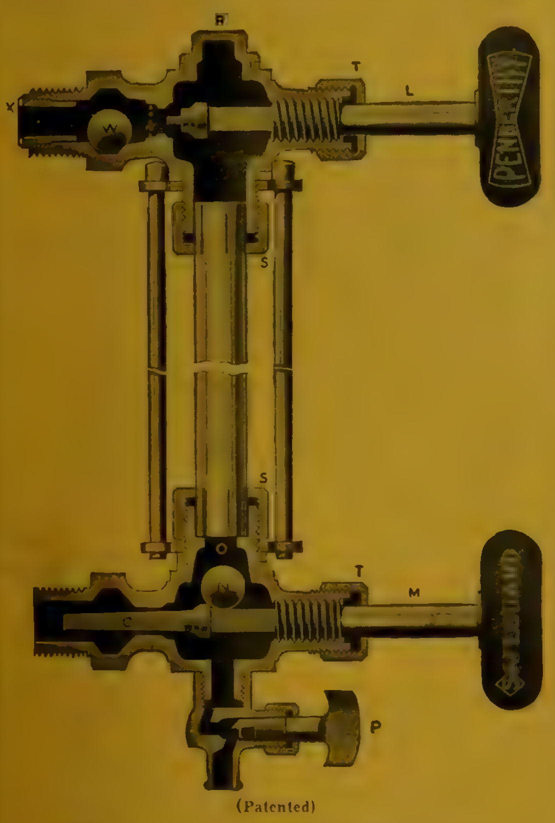
Vol. VII. Publication Office, Toronto July, 1914 No. 7

TRADE PENBERTHY MARK

SAFEGUARD

AUTOMATIC WATER GAGE



(Patented)
Solid Construction. Simple Automatic Action.
Equipped with Dripless Pet-cock.

MECHANICALLY CORRECT

It is the one certain protection against all accidents and injuries due to the breaking of the Gage Glasses.

The Upper Seat is designed to leak for purposes solely of sureness of operation at the proper time. Only dry steam escapes, and in small quantity, hurting no one. The leak equalizes the pressure in the glass and the boiler pressure, and the balls cannot stay seated unless glass is broken. This fact is positive, and any gage not made to leak on the upper arm is unsafe.

The "SAFEGUARD" is of solid construction throughout, and can be used with safety on very high steam pressures.

The "SAFEGUARD" has but two movable parts—the Automatic Ball Valves—which are so constructed that their action is absolutely dependable at all times.

A PROTECTION AGAINST ACCIDENTS AND INJURIES

Why not install a "SAFEGUARD" instead of that non-automatic you are using? The glass in your gage may break at any time, causing serious accident or even loss of life. YOU NEED THE "SAFEGUARD" IN YOUR BOILER ROOM.—TRY IT.

If your dealer cannot supply you, send us your order.

"THE SAFEGUARD WILL GUARD YOUR SAFETY."

MANUFACTURED BY

Penberthy Injector Co., Limited Windsor, Ont.

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For Any Service

Marine Boiler built for R. & O. Nav. Co. Str. "Rapids Prince"

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STEEL BUCKET
ELEVATORS

The handling of your raw materials is of more than little importance. Efficiency in this particular item means a saving, not only in dollars, but in time as well.

While there are instances where other methods spell "best practice," in nine cases out of ten the Waterous Bucket Elevator or Conveyor will do the work to the best advantage.

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For handling such gritty and bulky materials, the Steel Bucket System is undoubtedly without an equal.

We build Steel Buckets, Conveyors and Elevators in all sizes up to 600 tons per hour capacity. We make our designs to suit different conditions, and can bring twenty years of experience to bear on your particular case.

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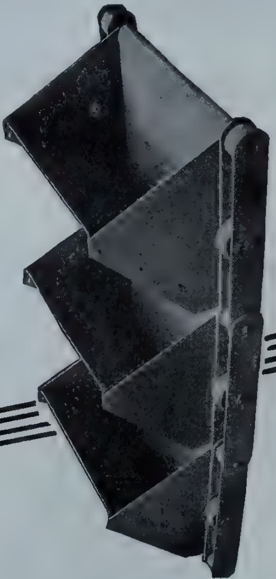
Waterous Steel Buckets are built to exact size, and will run easily and wear slowly under exacting conditions. They are unexcelled for handling rough and gritty materials.

Send us your sketches for quotations.



**The Waterous Engine Works
Company, Limited**

Brantford Canada

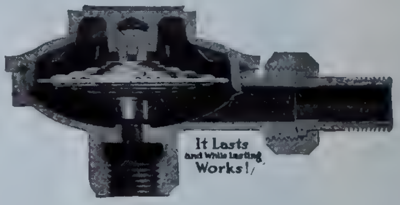
Business:--

Confidence is one of the principles which more than anything else goes toward making a success of your business. You cannot gain the confidence of one or more of your clients by the use of inferior material or something just-as-good-as what is required.

In Vacuum or Vapor Heating work the use of a real Radiator Trap will do for you just what any other quality article will do—establish confidence.

But be sure you get the Radiator Trap that performs the proper functions, while performing these functions lasts—and while lasting gives entire satisfaction.

The Dunham Radiator Trap will do just this. It will help build your reputation of reliability because it is built of quality and with the motive of service.



Passes water and air freely. Closes off tight against steam. Does not clog up.

Don't accept something just-as-good-as Dunham Traps until you have really satisfied yourself there is such an article.

We can be of service to you in many ways where it is a matter of heating—it is our business; and we feel will be to your interest to give us the opportunity.

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OUR MIXED METAL SALES AMOUNT TO OVER 5,000000 DOLLARS ANNUALLY

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TRAPS, BENDS,
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For babbitting dynamos and motors, you'll find our NICKEL GENUINE exceptionally good.

If your dealer cannot supply you with these babbitts, we shall be pleased to make you a shipment of a twenty-five pound box.

BE SURE TO TRY THEM.

Hoyt Metal Co., Toronto, Ont.

New York, N.Y.
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St. Louis, Mo.

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Just as the Heart

is the vital part of the human system, so are boilers the vital part of your plant.

If your boilers fail, your whole plant is affected. Therefore it is necessary to select them with the greatest care — to look into their past and present record of service, and get only the kind that give long, efficient service with least stoppage for repairs.

Jenckes Boilers are built to stand up under the most severe service.

They are well and favorably known throughout Canada, and have been for many years.

They are built to conform with the various Provincial Inspection Acts.

A well-assorted stock of boilers on hand constantly.

We will be pleased to send full particulars, and put you in touch with users in your town. To give us the opportunity of doing this is opening the way to greater economy, safety, and reliability in your plant.

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Vertical Tubular

Locomotive Types

Heating Boilers

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POTATO SCALE BOILER CLEANSER

Is a helper that's needed in your Boiler-room

It goes into the feed-water and destroys all scale-forming ingredients. It keeps the boiler clean and prevents pitting, corrosion, foaming and other boiler troubles due to impurities in the feed-water.

Its action is confined to the feed-water — it hasn't the power to cause the slightest injury to tubes or fittings.

It is made to suit feed-water conditions, and is **guaranteed** to produce satisfactory results.

Would you like to hear what users have to say? We will be pleased to put you in touch with some.

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1810-1840 11th Street East, Calgary, Alberta. P.O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid-Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches:— Edmonton, Winnipeg, Vancouver

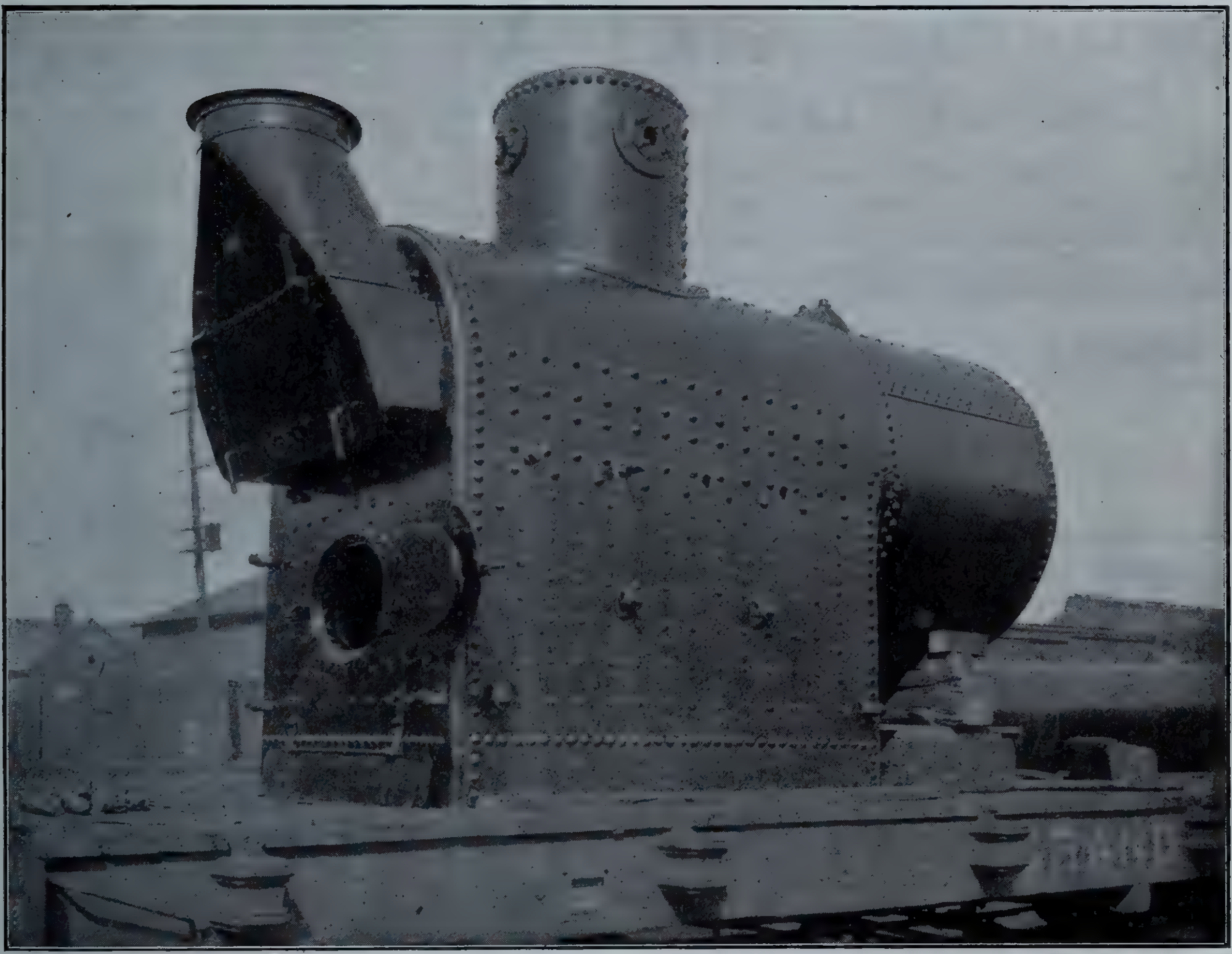
POLSON BOILERS

are built of best quality Flange Steel by skilled workmen.

The photo shows a 58″ square-firebox Marine Boiler that has just been completed by us for the LAKESIDE DREDGING CO.

It is just another example of the popularity of Polson products, amongst engineers and men who know and appreciate good equipment.

Put your plans and specifications up to us.



Polson Iron Works, Limited

Toronto, Ontario

The SIZE of your FUEL BILLS depends upon the condition of your boilers

Where boilers are neglected fuel bills are certain to increase.

If there is even 1-10 of an inch of scale on the tubes the fuel bill increases 15%.

Now, this waste of fuel can be prevented with practically no effort on your part.

A small quantity of **Walker's Electric Boiler Compound** used continually in your feed-water will keep scale from forming and prevent pitting, corrosion or other boiler troubles, due to impurities in the feed-water.

Remember, it **will not** injure your boilers, fittings or pumps—and will keep your **boiler at full capacity** and your fuel bills at a minimum.

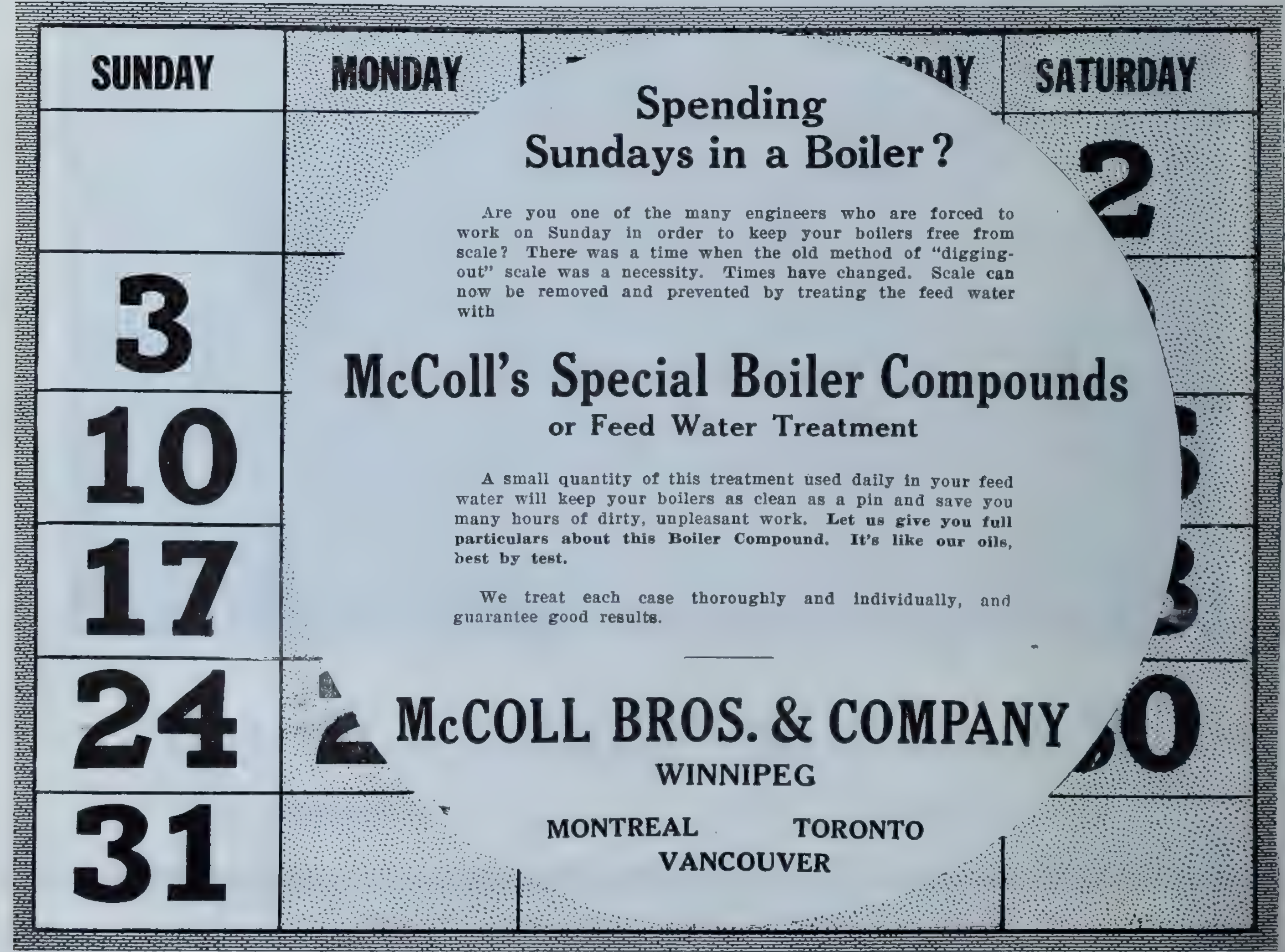
A barrel will convince you. Try one.

The Electric Boiler Compound Company, Ltd.

Guelph, Ontario

We also manufacture the following High-Grade Oils: **Regal Valve Oil; Red Star Cylinder Oil; Monarch Cylinder Oil; Heavy Red Machine Oil; Superior Engine Oil; Electric Engine Oil; Brush Dynamo Oil; Anti-Carbon Auto Oil.**

Try them and you'll be a constant user.



Spending Sundays in a Boiler?

Are you one of the many engineers who are forced to work on Sunday in order to keep your boilers free from scale? There was a time when the old method of "digging-out" scale was a necessity. Times have changed. Scale can now be removed and prevented by treating the feed water with

McColl's Special Boiler Compounds

or Feed Water Treatment

A small quantity of this treatment used daily in your feed water will keep your boilers as clean as a pin and save you many hours of dirty, unpleasant work. **Let us give you full particulars about this Boiler Compound. It's like our oils, best by test.**

We treat each case thoroughly and individually, and guarantee good results.

McCOLL BROS. & COMPANY

WINNIPEG

MONTREAL TORONTO
VANCOUVER

Perolin

The Boiler Metal Preservative

is fed in with the feed water the same as boiler compounds, but the action is different—and the results are better.

It loosens old scale so that it can be readily removed—and after scale has been removed it forms a preservative film over the tubes. This film prevents scale-forming substances from adhering, is a good transmitter of heat, and **prevents pitting, corrosion, galvanic action, etc.**

Perolin will not injure boiler metal or packings.

We stand ready to demonstrate how Perolin saves time and fuel in your plant at our own expense. We'll ship you, freight prepaid, a **sufficient quantity to test for sixty days.** If at the end of this trial period you are not convinced that **Perolin is worth a great deal more than it costs,** return what you have left, and there will be no charge for what you have used.

Our Booklet, "IT DOESN'T AFFECT THE WATER," gives the fullest particulars about Perolin, and the information contained therein will prove very interesting.

Drop us a card for it.

GUARANTEE

We guarantee PEROLIN, the German Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

Perolin Company
of Canada, Limited
76 Adelaide St. W., Toronto, Ont.

Quebec Agents: Burroughs, Joyce & Co.,
30 St. John Street, Montreal.

"Things are Goin' to be Easier for Both of Us, Bill."

"You've been shoveling more coal than you ought to, and I've been doin' more work than I ought to, but this little book and this P.P.P. rod packing are going to change things a whole lot."

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

So far as the book is concerned, you can get it by simply filling out and mailing the coupon, but to learn just what a lot of work P.P.P. will save by reducing FRICTION to the minimum and keeping you out of the engine room overtime and Sundays packing leaky, blowing stuffing-boxes, you must try a sample lot.

The action of P.P.P. is as automatic and sure as the motion of the valves of your engine. There is always sufficient pressure on the rod to hold steam-tight, but never more than the necessary requirement, be it 200 pounds or but 3 pounds. Other packings NEVER vary the maximum rod friction which must resist the highest requirement.

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Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name ....

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Employed by ....

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Horsepower of engine ....

Kind of Rod Packing used ....

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.... Series 24-G

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.
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Canadian Consolidated Rubber Co.
LIMITED

Executive Offices : Notre Dame Street, MONTREAL, P.Q.

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RUBBER GOODS BEST BY TEST FOR ALL PURPOSES

Air Brake Hose (regular) and special "Non-freezing" Air Signal Hose.
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"Star" Red Sheet Packing.
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Pure Gum Sheet.
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Special Moulded Goods for every Mechanical Use.
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Original "Diamond" design Inlaid Rubber Tiling. Estimates and Samples cheerfully furnished. We specialize in Rubber Goods required by Steamboat and Electrical Car Companies.

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ARE YOUR RODS WORKING
ON A CONSTANTLY LUBRICATED SURFACE,
OR ON
HARD CANVAS and
FRICTION PRODUCING RUBBER?

"PALMETTO"

is different from all other packings because it keeps the bearing surface of the rod automatically lubricated by reason of each single strand having its own abundant supply of graphite grease lubricant—our own special process.

Effect of Lubricant from packing itself

IS TO PREVENT
- **Rod Friction**
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"Palmetto" can be depended upon for satisfactory service. Let us send you a free working sample. We will not trouble you with salesmen.

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"Holdtite" Style No. 899

The Packing made specially for Extreme Pressures and Temperatures.

"Holdtite" will hold superheated and high-pressure steam, hot gases, ammonia, acids, alkalies, hot oils and other fluids and gases that are death and destruction to other packings.

Will successfully stand a temperature of 1500 degrees Fahr., and has a tensile strength of 6,000 lbs. per square inch. **Does not harden in joints.**

We offer every engineer an opportunity to test our style No. 899, so as to determine for himself whether or not our claims for the durability and efficiency of this packing are justified.

SEND FOR A SAMPLE TO-DAY AND LITERATURE

The GARLOCK PACKING COMPANY

Hamilton, Ont.

Montreal **Toronto** **Winnipeg** **Calgary**

"Pioneers in the Packing Business and Specialists"

See us at the Ottawa Convention

Are YOU a Progressive Engineer ?

If you are, we want to send you a copy of our Catalogue W 100 on "Columbia" Recording Gauges. For we know that every engineer, if he is a "live one," will recognize in an instant the great importance of the many new features in Recorder construction interestingly outlined in this catalog. A few are:—

The **adjustable** and **removable** Recording Pen Arm—chart changing made easy.

The popular "Day and Night" border chart with wide record area—a clear and intelligent record.

The non-corrosive and non-spilling glass Recording Pens—a perfect record line.

And many other important features found only in

"Columbia" Recording Gauges

Send a postal TO-DAY for a copy of Catalog W 100. You **need** it to be "up to the minute" on the Recorder question.

Thousands of "Columbia" Recording Gauges are in daily operation in the most successful Power Plants throughout this country, the States and abroad. Is **your** plant one of this number? If not, NOW is the time to get in the "Columbia" class. Your order NOW entitles you to a

Handsome and Practical Chart File FREE

Just the thing to accommodate Recording Gauge Charts. We are only offering this FREE for a short time, so send in your order QUICK. One with each "Columbia" Recording Gauge ordered.

The Schaeffer & Budenberg Mfg. Co.

Makers of the "Columbia" Recording Thermometer and other Instruments for Power Plants.

Brooklyn, N.Y.

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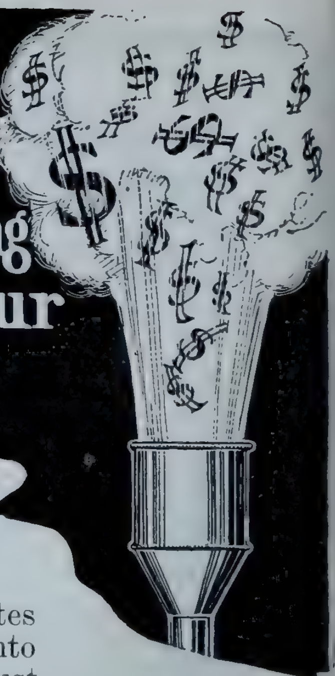


Save the dollars you are losing through your exhaust

Every puff of exhaust steam from your plant actually evaporates your good dollars into thin air. This exhaust still retains 90% of its original heat and will bring you big profits if you utilize it for heating surrounding buildings.

You can convey steam to buildings thousands of feet distant—with practically no loss of heat—when your underground pipes are installed in

J-M Sectional Conduit

This conduit *saves* 90% of the heat lost in transmission through poorly covered or uncovered pipes.

Unlike wooden conduits and brick and concrete tunnels, it never deteriorates. Water, fire and the chemical action of the earth have no disintegrating effect on it. Won't break under heavy weight.

J-M Sectional Conduit is made of special tile, salt glazed inside and out. Comes in upper and lower sections. This permits the space between the pipes to be filled with our combination of Asbestos Fibre and ground sponge—a material universally recognized as the best insulator against the radiation of heat.

Our Catalog No. 112 fully describes *all* the money-saving features of J-M Sectional Conduit. Write nearest Branch for a copy.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LTD.

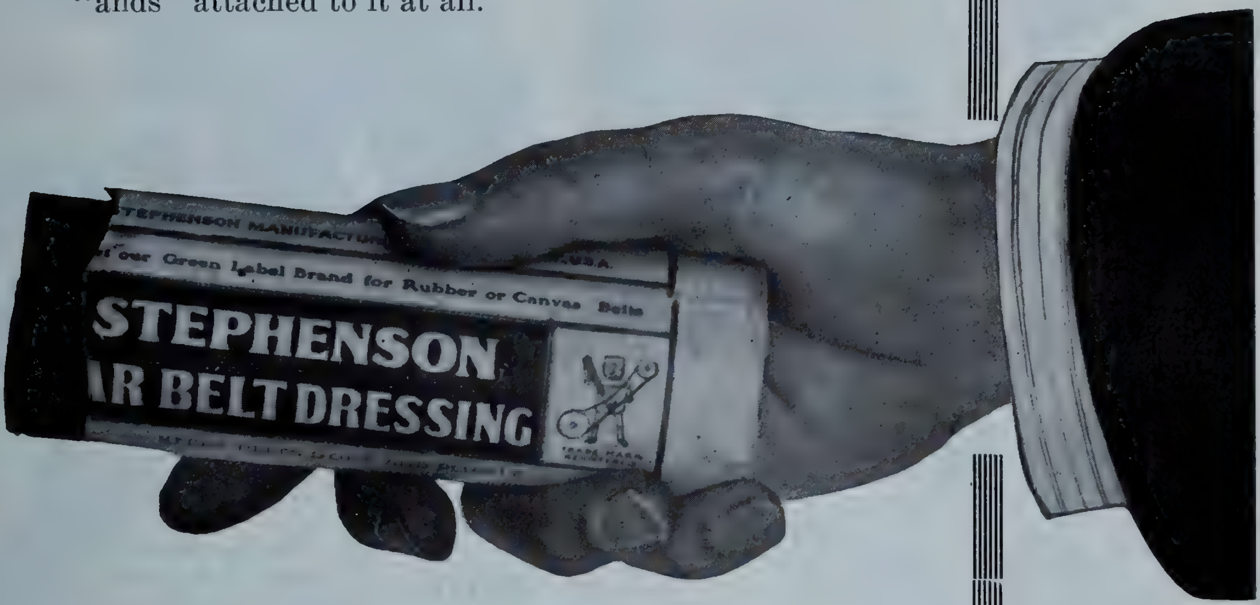
MANUFACTURERS OF ASBESTOS PACKINGS; PIPE COVERINGS; HIGH TEMPERATURE CEMENTS; BOILER PRESERVATIVE; METALLIC HOSE; FUSES; BOILER PLUGS; STACK LINING; TUBE CLEANERS; ETC.

TORONTO **WINNIPEG**
MONTREAL **VANCOUVER**

2097

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



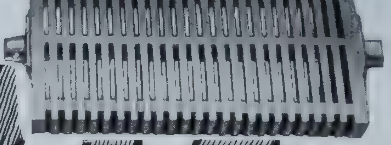
We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson
Manufacturing Co.
Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me **free of charge** a half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....



"CYCLONE"

Shaking and Dumping

GRATES
Lower Fuel Cost

The burning of low-grade fuel and the getting of proper combustion is made possible by the 60% air space and 90% underdraught

The improved shaking mechanism means more vigorous and effective shaking, it keeps the grate free from ashes and clinkers and doesn't allow any fuel to be wasted.

The perfect balance makes shaking and dumping exceedingly easy.

The Cyclone locks level. It cannot get out of adjustment or become warped.

They burn any grade of hard or soft coal or screenings with results equal to that of the best.

We are prepared to instal our grates in the plant of any bona-fide company on 30 days' trial. They are easily and quickly installed; no shut-down of plant or no expensive changes in brick-work required.

If satisfactory, we will expect payment as agreed on, and if not, we will remove the grate without cost or lost time to you.

See that you get the genuine "Cyclone," not an imitation. There's a world of difference in service.

The Canadian Steam Boiler Equipment Co., Limited

SOLE MANUFACTURERS FOR CANADA

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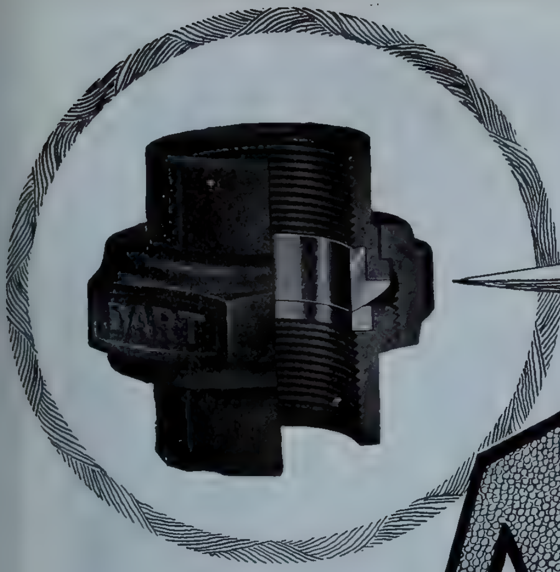


DART

BRONZE TO BRONZE

At the Joint

Dart Unions do not deteriorate at the joint. When put on the job they stay tight until deliberately loosened with a wrench.

Easily Connected

Never Corrodes

The ball-shaped joint makes connecting easy, whether pipes are in or out of alignment.

Corrosion, vibration, or expansion have no effect upon the Dart's efficiency.

Every union that bears the trade-mark as shown herewith will be replaced two for one if defective.

Write your Jobber

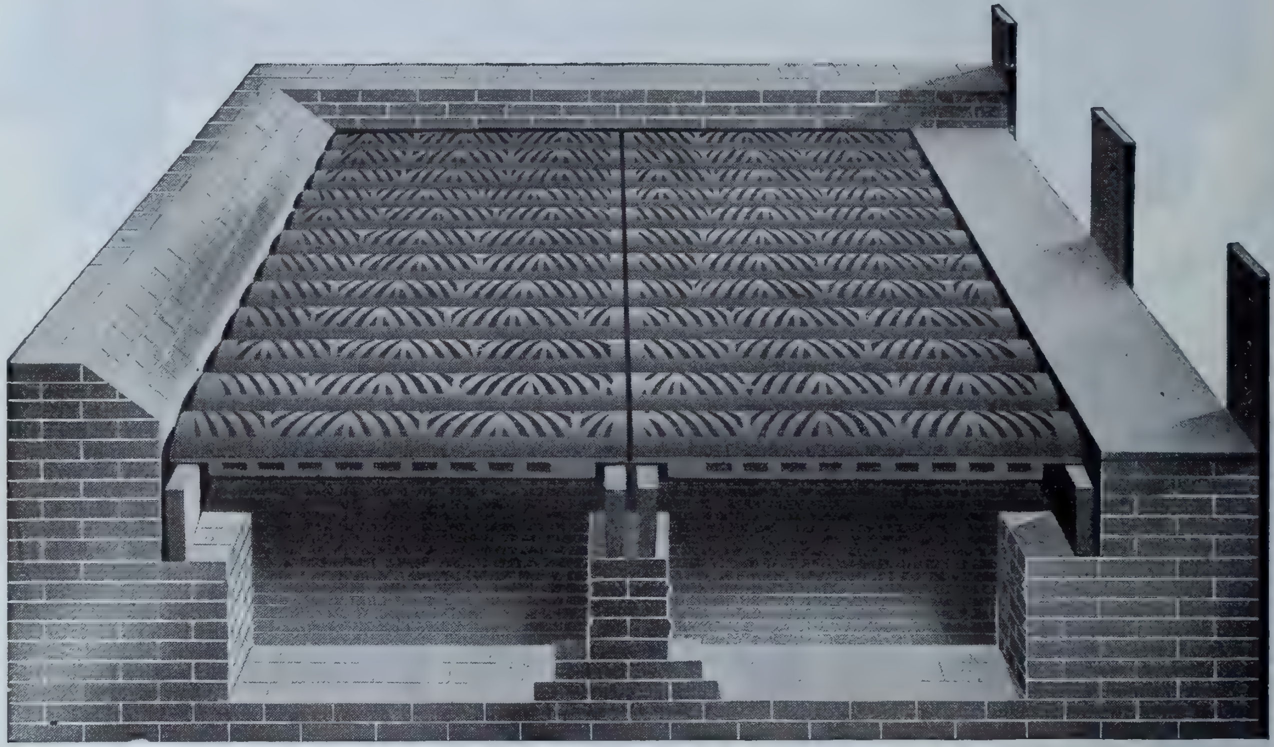
TRADE DART MARK

Dart Union Co., Limited
TORONTO, ONT.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS— PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

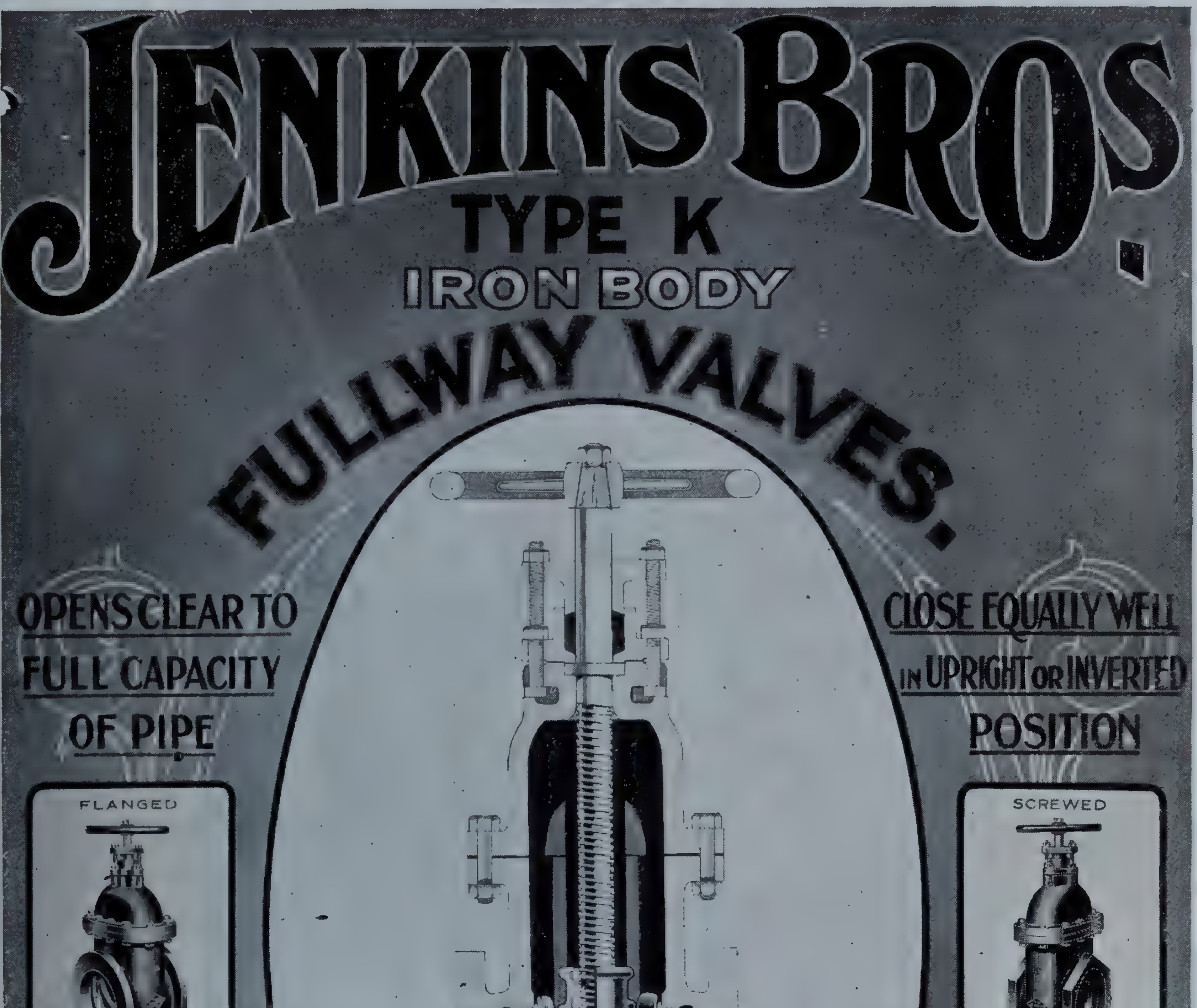
FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

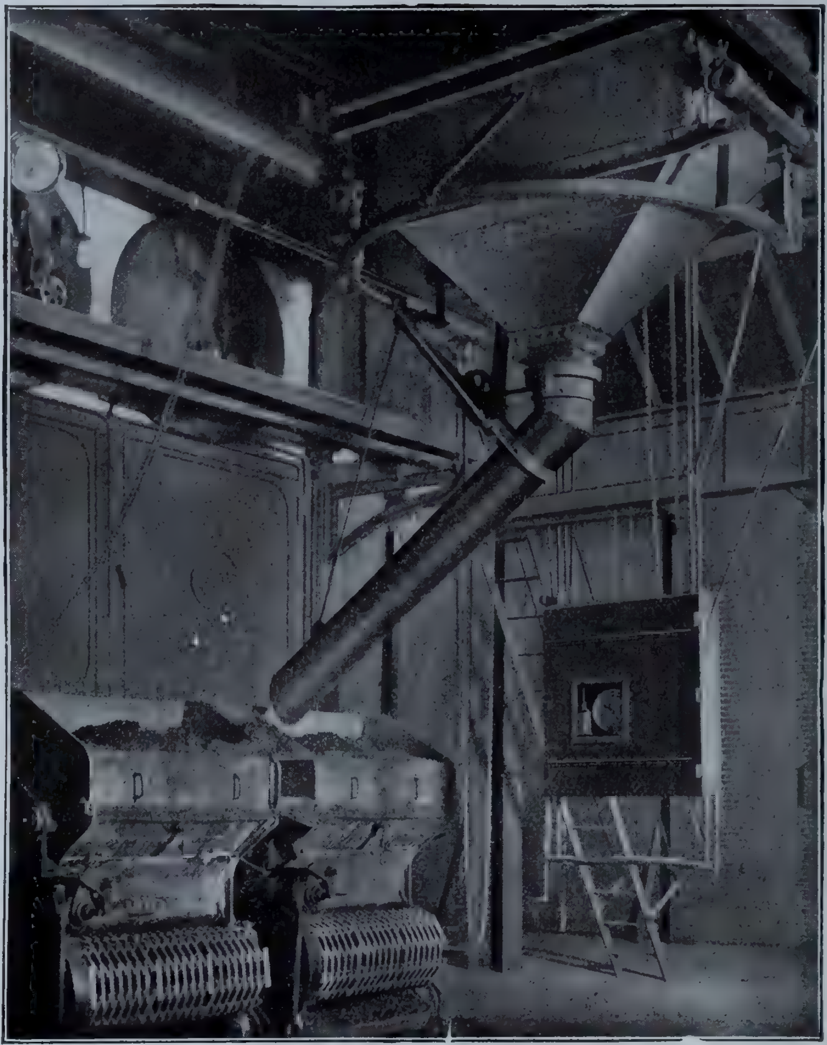
THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.


JENKINS BROS.
TYPE K
IRON BODY
FULLWAY VALVES.
OPENS CLEAR TO FULL CAPACITY OF PIPE
CLOSE EQUALLY WELL IN UPRIGHT OR INVERTED POSITION
FLANGED
INSIDE SCREW
SCREWED
INSIDE SCREW
RENEWABLE BRONZE SEAT RINGS SCREWED INTO VALVE BODY
DISCS FACED WITH BRONZE DISC-RINGS FORCED INTO DOUBLE-GROOVED RECESSES
GATES CAN NEITHER JAM NOR CHATTER
GATES CLOSE POSITIVELY WITH BALL BEARING ACTION
HUB END
FITTED FOR KEY
TRADE JENKINS MARK
FLANGED
OUTSIDE SCREW & YOKE
Jenkins Bros

STOCKED BY DEALERS EVERYWHERE

Catalogue Mailed Free upon Request

103 St. Remi St. **JENKINS BROS. Limited** Montreal



Pounds of Coal per H. P. per Hour

You must know how many lbs. of coal you burn each day in order that you may keep your power cost down to a minimum.

A Fairbanks Scale

will tell you quickly and accurately. The above illustration shows the application of a one-ton Fairbanks Suspension Coal Scale, with quick-weighing dial and mounted on a trolley.

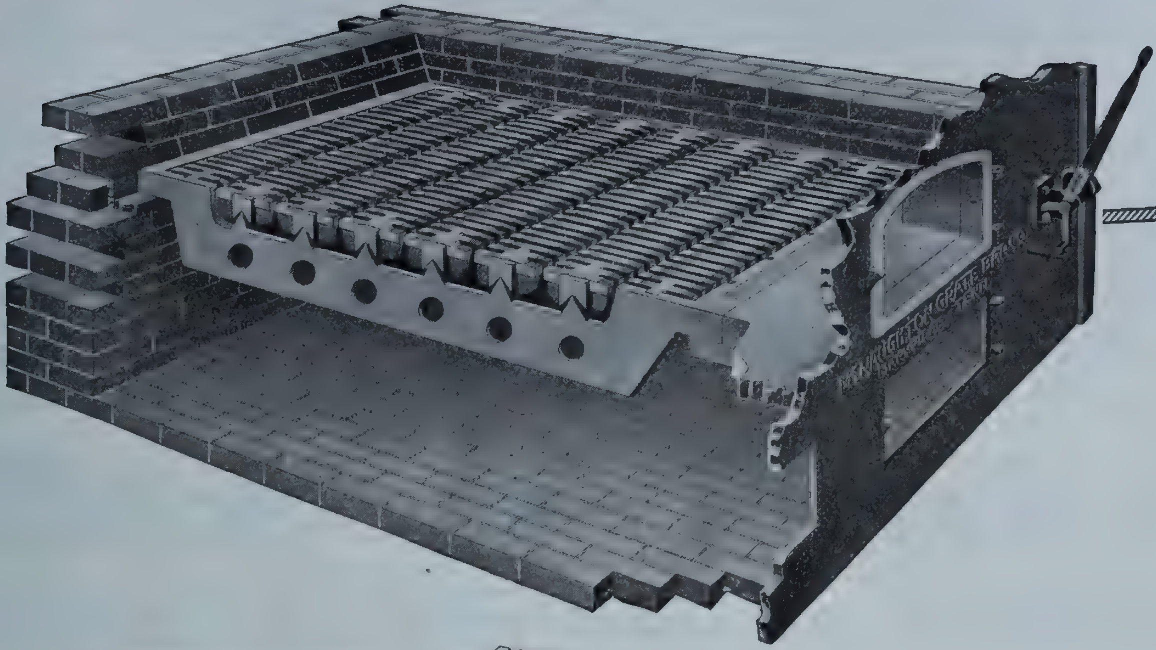
Let us know the conditions in your power house and we will advise you as to the best method of handling your weighing problem.

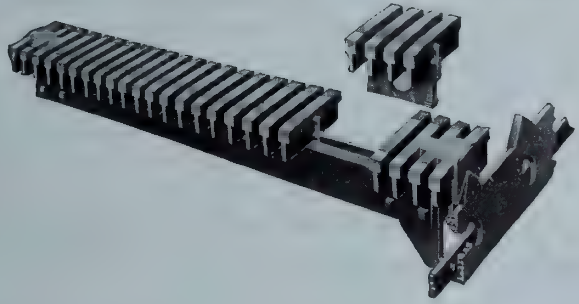
The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Quebec Ottawa Toronto Hamilton Ft. William
Saskatoon Calgary Edmonton Winnipeg Regina Vancouver Victoria

Canada's Departmental House for Mechanical Goods

The McNaughton Grate





Produces a most notable improvement in fuel burning.

Its design ensures even distribution of draft spacing free from extra metal at the fire surface. There is room for expansion between each section, and no part of the bar is ever under any heat strain. The McNaughton Grate will, under the most severe use, stand up without sagging or buckling if given proper care.

No dead space. Open air spaces clean across the bar.

Method of construction makes repairs easy and often saves the purchase of an entirely new bar. Reduces cost of upkeep from 50% to 75%. Enables one to always keep it in first-class condition. Although the character of the results from the use vary in different places, according to fuel, condition of brickwork, and dimensions of stack; the general results indicate **A SAVING IN FUEL** through more **efficient combustion**, decrease in density of smoke, easier firing, and considerable increase in capacity of boilers for overload.

Installed for 30 days' free trial. Write for full details.

Will exhibit at the convention of the Canadian Association of Stationary Engineers, at the Canadian National Exhibition.

Mr. F. W. Donaldson, of 422 Euclid Avenue, Toronto, will be in charge of exhibits.

Be sure to pay him a visit.

GALT FOUNDRY COMPANY
GALT, ONTARIO

Educational Talks on Leather Belting.

Proper Selection of Belting

(Widths, Weight and Quality)

The use of belting constructed to meet each condition of service insures low cost of operation and maintenance as well as the maximum production from machinery.

A belt should be capable of transmitting from 5 per cent. to 25 per cent. more power than is actually needed; the excess capacity being governed by the type of drive, ranging from 5 per cent. for heavy main drives to 25 per cent. for machine belts.

Too Wide vs. Too Narrow Belting.

Never use belts full width of the pulley face as a slight misalignment may cause part of the belt to run beyond the edge of the pulley and perhaps against a shifting finger or pulley flange, resulting in loss of power and frequently in a badly damaged belt.

A belt too narrow necessitates high tension to transmit the required power, thus causing excessive journal friction, consequent loss of production and the early destruction of the belt. Thin, wide belts give the best service working vertically. A thick, narrow vertical belt will not grip the pulley well.

Single vs. Double Belting.
Heavy vs. Light.

In general, single belts, if heavy enough to carry the load, should be used on small pulleys. A single belt should never be used where the width is more than 1 1/3 times the diameter of the smallest pulley. Where small diameter pulleys and the load would require an unusually wide single belt, it is advisable to substitute narrower pulleys and a narrower light double belt.

Double belts of medium or heavy weight should never be used on pulleys less than 12 inches in diameter, and it would be better to adopt 20″ as the minimum diameter.

Belts too heavy for the load weave back and forth on the pulleys. This is best illustrated by a belt working under intermittent loads, the belt running straight while carrying the maximum or proper load, but showing a tendency to weave when the load is considerably reduced.

Center Stock vs. Side or Shoulder Stock Belting.

Belting made from center stock leather (first quality belting (should be used to carry heavy loads or where the conditions are unusual. For certain light work or underloaded countershaftwork, side stock or even shoulder stock belting (second quality) will often meet the requirements satisfactorily.

Do not, however, be deceived by so-called first quality double belting made with one-ply center stock and one-ply shoulder stock; the two cuts and qualities of leather do not stretch uniformly and a belt so constructed will soon give trouble.

Oak Tanned vs. Spartan Belting.

Oak Tanned leather belting is recognized as the best belting for ordinary conditions.

For overloaded drives, where it is not feasible to get greater power by increasing the belt speed or the width of pulleys to enable the use of wider belts, recourse must be had to our Spartan Brand of Belting, remarkable for its pliability and, consequently, increased pulley grip and its great tensile strength. Where abnormal external conditions exist Spartan Belting should be used, as the specially tanned leather and the special cement used in its construction resist the injurious effects of water, heat, steam, oil, gases and acid fumes.

The above suggests only a few of the problems which must be met in installing a drive of maximum efficiency, but it illustrates the importance of carefully considering this question. Our Engineering Department is ready to solve any transmission problem, investigate or design any drive upon request. If you have certain belts or drives which are a source of annoyance and expense, consult us. Authentic engineering advice promptly submitted.

Subject for next month:—"Proper Installation of Belting."

THE GRATON & KNIGHT MANUFACTURING CO.

Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory: Worcester, Mass., U.S.A.

"Consult our Engineering Department in connection with your Transmission Problems"

"Price" vs. "Service"

How Are You Buying Your Plant Equipment?

Why should you **pay** for unknown quality, when what you seek is **service?**

The equipment bought "on price" will never inspire any great confidence. Break-downs are costly. And break-downs and ordinary equipment go together.

Hose is an important part of your equipment. It is something you use as a vehicle of **service**. If the hose is faulty, you lose.

So when you buy hose, buy it the Goodyear way. Tell your needs to Goodyear efficiency experts. They have already designed the very hose for your particular purpose. They can tell you **why** it is the hose you seek. Knowing **why**, beforehand, is better than learning "why not" through inefficient service of an ordinary product made to meet a price.

"Black Diamond" Brand

A high-pressure hose. Has a marline woven jacket and different constructions and tube compounds for air and steam. The marline cover allows for even expansion and comfortable handling. A durable hose that can be depended upon for day-in-and-day-out service—Economy.

"Goodyear" Brand

Similar to "Black Diamond," but has a special steam and heat resisting tube. Won't "cook itself to death" like an ordinary hose. Rapid hardening cannot take place.

Also comes wire wound. This adds to the durability where hose is roughly handled and used. Protects the outer cover. Keeps the hose intact under most grueling conditions.

GOODYEAR
TORONTO
HOSE FOR ALL SERVICES

Switchboard and Dynamo Mats

Either plain or corrugated. The rubber is so carefully compounded that every mat is an absolute insulator. That's a mighty important factor where safety is so vital.

Belting, Packing, Valves

Consult Goodyear experts whenever you need Belting, Packing or Valves for any purpose. Remember that each Goodyear product is made to meet an exact need—based on scientific investigation, tests and service.

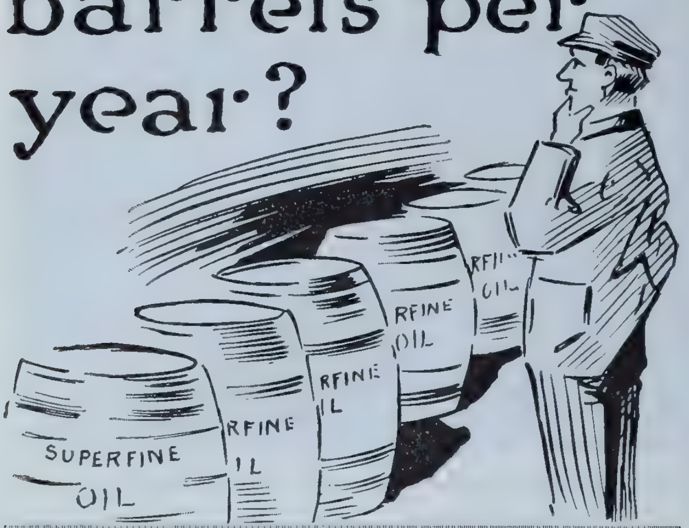
Ask questions of Goodyear experts. This costs you nothing. Yet it will save you good money, time and trouble.

These products are Canada-made. Back of them are the same quality-standards that have won leadership in tiredom.

The Goodyear Tire & Rubber Co. of Canada, Limited

Head Office, Toronto, Ont. **Factory, Bowmanville, Ont.**

How many barrels per year?



It Depends on the Method of Lubrication You Use

Whether you buy 100 barrels a year, or *use* 100 barrels a year and buy but 10. It is, then, up to you to lubricate correctly and *most efficiently.*

THE BOWSER SYSTEM insures you as near 100% efficiency as you'll ever get. It gives the oil unfailingly. It catches it again and returns it to the most efficient clarifying device ever made.

Three square feet of filtering surface for every gallon of oil per hour takes out *every impurity* after the heavier, coarser matter has been extracted by gravity. And—this process goes on *time after time.* No oil is wasted—no deterioration can take place —quantity is reduced but slightly—*you'll order far fewer barrels per year*—and you know how much a barrel costs.

Get the new Bowser Book. A request does not obligate you in any way.

S. F. Bowser & Company, Inc.
32-74 Frazer Avenue
Toronto, Ontario, Canada
Engineers and Manufacturers of Oil Handling Devices
Sales Offices in all Centers and Representatives Everywhere

Bowser Engine Connections J. G. Brill Company Phila., Pa.

Bowser Oil Clarifying System Installed for the National Cash Register Co.

If you could make a safe legitimate investment of $100 bring you back $200 in a year's time, would you do it?

We would and we think *you* would. However, the mere doubling, tripling or quadrupling of money doesn't begin to touch the possibilities from Cling-Surface.

As we recently showed you, Cling-Surface treatment of belting can be the direct means for saving from $90.00 to several thousand dollars per year by reducing transmission friction in belted plants of from 50 to 1,000 h.p. Considering the very small expenditure for a few pounds of Cling-Surface and considering the large return, what better investment could you make?

An example: The 10-inch belt in the plant of the Aird-Don Co., Troy, N.Y., as shown in the picture, transmits 40 h.p. from a 14-foot to a 30-inch pulley on 30-foot centers. The engineer here, Mr. Louis J. Landmeir, tells us that scientific treatment of this belt with Cling-Surface costs him only 90 cents per year. Then he goes on to say:

"Belt has had Cling-Surface treatment about three years. Is very pliable. No trouble with lacings pulling out or with belt slipping. Never have to take up belt. Used various belt dressings, but never had such success as with Cling-Surface."

Can you imagine how 90 cents could have been spent to better advantage?

Don't you think Cling-Surface worth investigating? Are your belts pliable? Do they run slack like the one in this picture? Do they pull maximum loads without slip? Are they waterproof? Durable? Troubleless?

They would be under Cling-Surface treatment.

Proof of all our claims awaits your inquiry.

We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

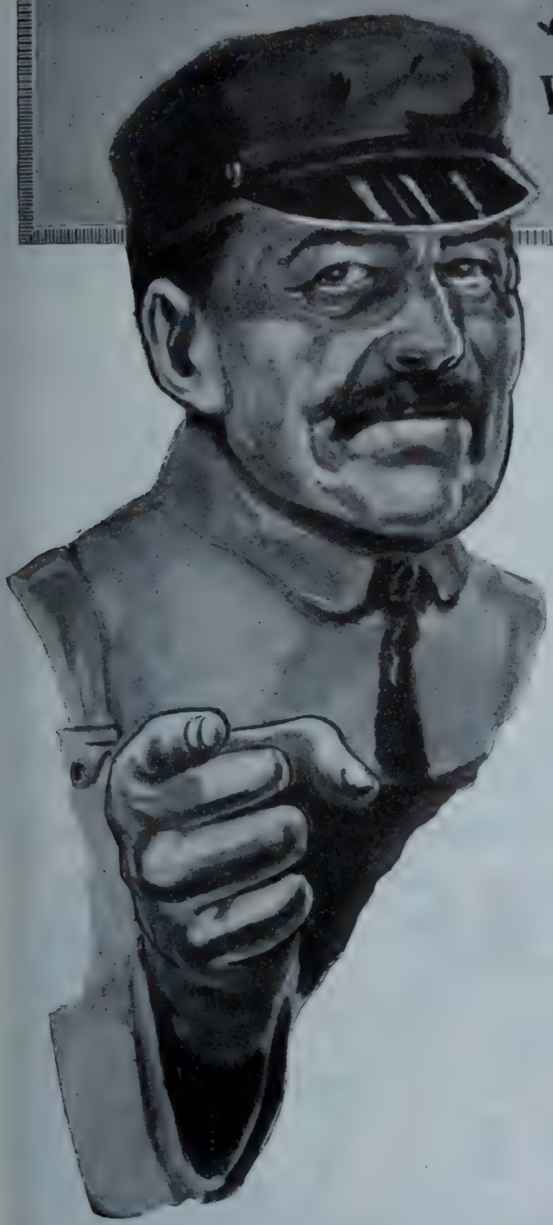
Cling-Surface Co
1057 Niagara Street
Buffalo N Y

I am interested in Cling-Surface and your trial order proposition.

Name .... Position ....
Firm ....
Street ....
City .... State ....

74

"Belting trouble ends where D. K. McLaren's Belting begins"



"I'm getting a SERVICE, brother, —the kind you're wishing for"

If you find it difficult to keep the wheels turning without continual belt attention, you owe it to yourself and your company to give **D. K. McLAREN'S GENUINE BRITISH OAK TANNED LEATHER BELTING** a trial.

We have expert hide selectors and expert workmen in our employ. These, in conjunction with our **Genuine British Oak Method of Tanning,** which gives leather great strength, durability, and flexibility, are a good reason **why** our belting is in the highest estimation of all who know.

The merit of "D. K. McLAREN'S BELTING" has placed it in many of the largest Canadian Power Houses.

Genuine Oak

We will be glad to put you in touch with users so that you can benefit by their experience.

Montreal
351 St. James St.

St. John, N.B.
64 Prince William St.

D·K·McLAREN
LIMITED

Toronto
200 King St. W.

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Patented

"AMERICANS"

SAFETY
EFFICIENCY
ECONOMY

Send for particulars.

Stocked and Sold by DEALERS

in

Sizes from 3 in. to 66 in. diameter. Larger sizes on application.

Safety—Beaded Edged Rim.
Efficiency—Correct Crown and Grooved Face.
Economy—Arms that cut the air.

MADE BY

The American Pulley Co.
Philadelphia Chicago New York Boston

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS:—Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N. B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.

"MAPLE LEAF"

Stitched Cotton Duck Belting

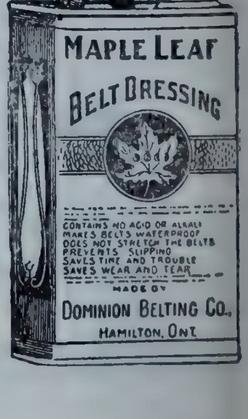
Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada



"Would Not Use"

"MAGNOLIA"

"If It Did Not Fill the Bill"

A. G. MARSCHER
PRINCE'S BAY MACHINE AND BOAT WORKS

All kinds of Machines and Marine Work, Launches Built and Overhauled. Marine Engines installed. Automobile and Marine Engine Repairs and Supplies. Winter Storage.

Prince Bay, Staten Island, Oct. 24, 1913.

Magnolia Metal Co.,
New York, N.Y.

Dear Sirs:—

Your letter of the 23rd received. I always carry MAGNOLIA ANTI-FRICTION METAL in stock, and have been using your Metal for past TWENTY years, and have always found it the best Metal I could get for Crank Shafts and Connecting Rods; on Marine Engines, Stem Bearings, Propeller Shafts, and many other bearings.

There is here to-day Crank Shaft and Connecting Rod bearings that I put in FOUR years ago, and they have been running daily ever since; the wear is so little to-day that there is no perceptible lost motion in them. Also SIX years ago I put in bearings in a Marine Engine now in Guantanamo, Cuba, and they are still running O.K. These are all heavy working engines. I have put in hundreds of bearings of MAGNOLIA ANTI-FRICTION METAL, and all gave good satisfaction, so there is no need of writing me about your Metal, because I assure you if it did not fill the bill I would not use it.

Yours very truly,

A. G. Marscher.

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

DURABLA

Superheat

Wet Steam

High Pressure and Oil

SOLD IN SHEETS AND GASKETS

Durabla Gasket makes a tight joint and keeps it tight.
Durabla Sheet rolls and unrolls.
Never cracks or dries up.

Manufactured by

DURABLA MANUFACTURING CO., NEW YORK

Canadian Sales Agents

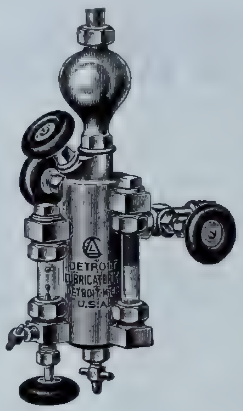
CANADIAN FAIRBANKS-MORSE CO., LIMITED

Montreal, Ottawa, Calgary, St. John, Toronto
Saskatoon, Quebec, Winnipeg, Vancouver.

Don't Gamble With Lubricators

Poor lubrication means increased friction and increased friction means loss of power, bigger fuel bills and more wear and tear on the engine.

Poor lubrication may result in an injured engine, expensive repairs or a complete shut-down at a most inconvenient time.

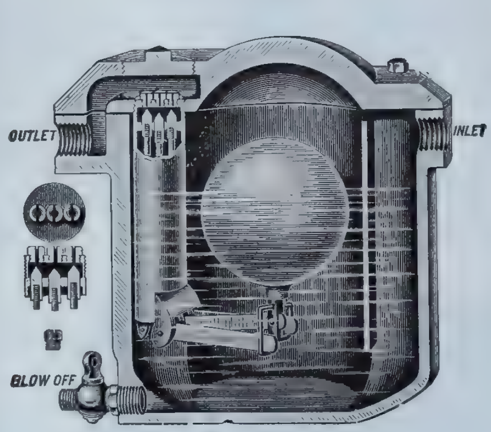


It doesn't pay to take chances with your lubrication because there is too much at stake.

Detroit Lubricators are designed to eliminate every element of chance or uncertainty from the lubrication of any kind of machine.

Over half the lubricators in the world are Detroits and wherever a Detroit Lubricator has been used the name Detroit has come to stand for sureness and certainty.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.



THREE VALVES

GREAT CAPACITY

Wright
"Emergency" High Pressure Continual Flow Steam Trap

Keeps the steam line automatically and continually drained of accumulating condensation.

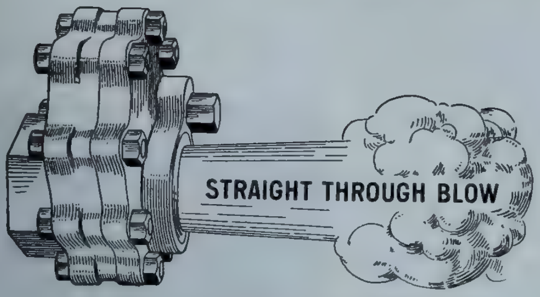
Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited
15 Ottawa Street, MONTREAL
TORONTO WINNIPEG ST. JOHN, N.B.

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!

WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiler & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

LUNKENHEIMER

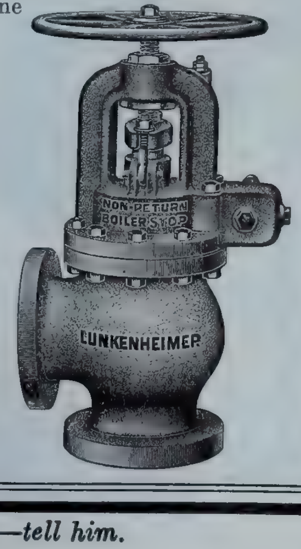
NON-RETURN SAFETY BOILER STOP VALVE

Prevents steam from other boilers of a battery discharging into one that is disabled. A sudden decrease in pressure in any boiler will cause a Lunkenheimer Non-return Safety Boiler Stop Valve attached to that boiler to immediately close, and will not open until the pressure equals that of the other boilers in the battery.

Among other products manufactured by the Lunkenheimer Company may be mentioned Globe, Angle, Cross, Check, Lever, Gate, Pop Safety, Relief, Throttle, Blow-off, Screw-Down Check Valves, etc.; "Puddled" Semi-steel and Cast Steel Valves of all types; Water Columns, Gauges and other Boiler Mountings; Whistles and Ground Key Work of all descriptions; Injectors and Ejectors; Lubricators and Lubricating Devices; Oil Pumps, Oil and Grease Cups, Gasoline Engine Appliances, etc.

Your local dealer can furnish them; if not, write us.

A complete description, with illustrations of the Non-return Safety Boiler Stop Valve, together with the entire line, can be had by referring to Lunkenheimer Catalogue No. 50. Write for a copy.



THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI, OHIO

10-43b

NEW YORK CHICAGO BOSTON LONDON

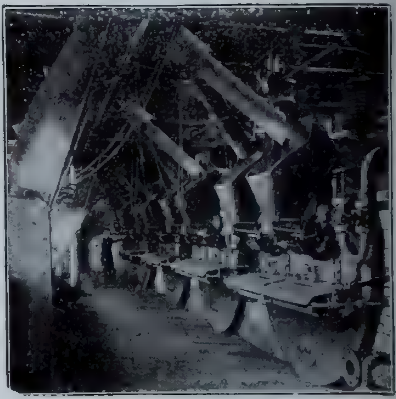
"Bennis" New Long Life Link Chain Grate Stokers.

Bennis Chain Grate Stokers
Bennis Machine Stokers

with Patent Self-Cleaning Compressed Air Furnaces for Water Tube and Horizontal Return Tube Boilers.

Bennis Machines are supplying over 3½ Million Horse Power and are saving Millions of Dollars a year.

"BENNIS" machines feed the fuel where the fire requires it, keep the fire at a nicely calculated distance from the boiler front, and respond to varying loads with a rapidity that is the outcome of good design. They ensure the maximum results from the boilers, reduce the fuel bill, and keep clean chimneys because they ensure good combustion.



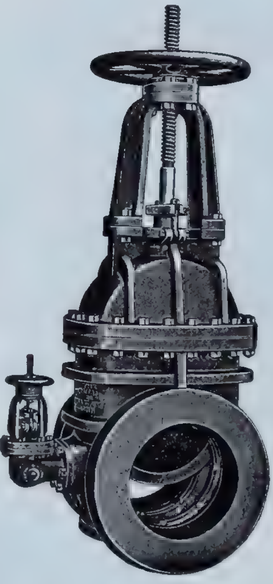
For Good Steam without Smoke install "Bennis" Machine Stokers and Elevators

"Bennis" stokers are not simply made from one design and adapted to meet the requirement of different types of boilers, but are specially designed for the various types, constructed with the greatest care and fitted to meet individual conditions.

The greatest economy is achieved when Bennis elevating and conveying plant feeds the stokers. "Bennis" coal and ash-handling plant has acknowledged advantages over other types, not only in design and construction, but in the small amount of power required to operate it effectually.

Write for "Boiler-House Economy" pamphlets and full particulars to

GEO. H. TOD, 213 Manning Chambers, Queen St. West. **TORONTO**
WINNIPEG, 601 UNION BANK BUILDING



Pratt & Cady Valves
with Renewable Bronze Seat Rings

Those who are looking for a valve of the highest grade, one which they can rely upon to help in their "Safety First" campaign, will do well to choose the P. & C. line of gate valves, made in Brass and Iron from 1¼" up; they all have the same

Retaining Ring Construction

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. These seats can be renewed by removing the retaining rings with a suitable wrench made for the purpose, or other appropriate tool. The gate is a double-faced, wedge-shaped casting, with side grooves by means of which it slides on guides in the valve body.

Great pains are taken in the machining of all parts of these gate valves. Gauges are used on each part to insure their accuracy and interchangeability. The guides in the bodies are of equal thickness, and the wedges can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double-seated can be used with the pressure applied at either end.

For Superheat and High Pressure, Wet Steam and Oil, use Durabla Packing.

The Canadian Fairbanks-Morse Co., Limited

Montreal **St. John** **Quebec** **Ottawa** **Toronto** **Hamilton** **Ft. William**
Winnipeg **Regina** **Saskatoon** **Calgary** **Edmonton** **Vancouver** **Victoria**

Canada's Departmental House for Mechanical Goods

SMOKE MEANS WASTE

Apparent to all but the one most concerned

SMITH CO.
15% to 30% WASTE
COAL BILL
He Runs A Gas Producer—But He Wastes The Gas
He Has His Sign Wrong—It's A Smoke Factory
Yes, There's A Fine Bunch Of Profits Going Up That Stack
I'm Glad We Don't Work Down Here. Think Of All That Soot
Suggested by M C Ilvgette
POWER

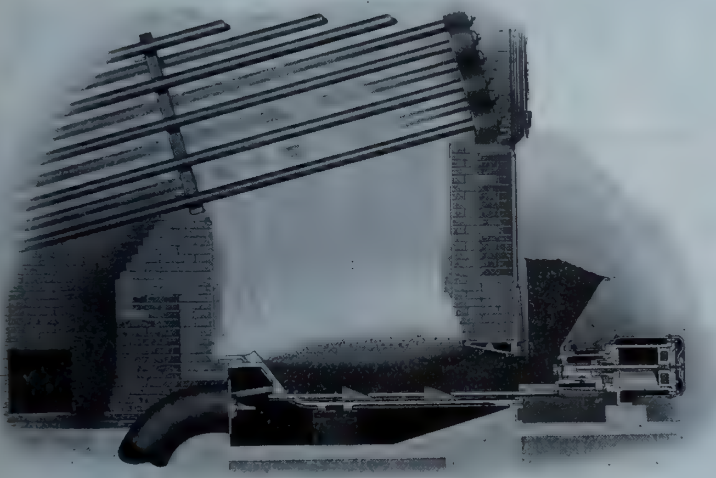
This cartoon—by "Power"—is self-explanatory; it is a showing of a "Manager" kicking about "Coal Bill" and ignoring the wasteful condition of boiler-plant equipment.

Smoke is a sure indication of waste of heat—money—value of coal fuel.

Determine 20 per cent. of your annual coal bill, and you will approximate the dividend-earning power of money investment required for **Murphy Automatic Smokeless Furnaces.**

MURPHY IRON WORKS,

DETROIT, MICH.
BUFFALO, N. Y.



"How Can I Show Lower Operating Costs?"

Not by turning out an inferior product, which promptly "finds its level" in a reduced price!

But

By the Cheaper Production of Steam

you can "show the goods" of sterling value for less money!

It gives your whole plant a reduced operating cost!
It puts your manufactured product of standard quality on the market with increased profits.

Steam is produced from 15 to 25 per cent. cheaper by boilers equipped with Jones Underfeed Stokers, and more steam per boiler without objectionable smoke.

Jones Underfeed Stoker Company, Limited

National Trust Building - Toronto

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

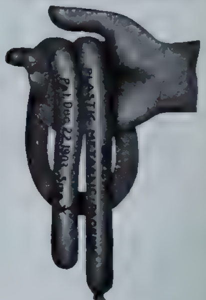
SAFETY PLASTIC
METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.
Manufactured only by
STEEL MILL PACKING CO., WINDSOR, ONT.

Practically Frictionless



Any Quantity sent on APPROVAL

Eugene F. Phillips Electrical Works, Limited
MONTREAL CANADA

Bare and Insulated Electric Wire

Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER
1144 Homer Street

MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.
District of Montreal

Our Specialties are Built under Experienced Supervision.

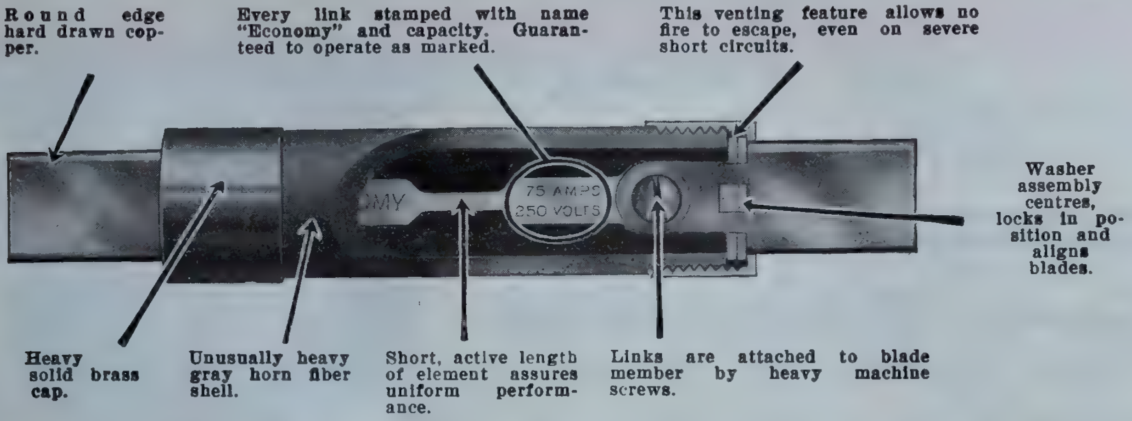
Try us when in the market for
Oil Switches,
Disconnecting Switches,
Switchboards, etc., etc.

No. 9402

No. 9184

No. 222

No. 950


Round edge hard drawn copper.
Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.
This venting feature allows no fire to escape, even on severe short circuits.
MY
75 AMPS 250 VOLTS
Washer assembly centres, locks in position and aligns blades.
Heavy solid brass cap.
Unusually heavy gray horn fiber shell.
Short, active length of element assures uniform performance.
Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited
Unity Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

THE UNBREAKABLE KIND

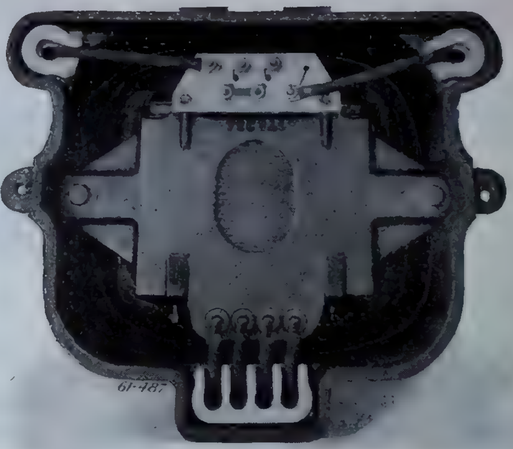
Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN JR. COMPANY

Live Agents wanted all over Canada. 23-25 Dowd Street MONTREAL

How's the Voltage out at the end of your line?



By means of the connecting board in the

Wagner HIGH EFFICIENCY Transformer

you can change the ratio of transformation, bring the secondary voltage up and thereby make the lights bright without increasing your copper. It is a small matter to shift the links on the connecting board so as to obtain several ratios of transformation.

We have a bulletin that covers the complete line. Write nearest house for copy.

Northern Electric Company
LIMITED

WIRES & CABLES
Northern Electric Company LIMITED
FIRE ALARMS TELEPHONES SUPPLIES

Backed by the guarantee of the Premier Canadian Electrical House.

Montreal
Halifax
Toronto
Winnipeg
Regina
Calgary
Edmonton
Vancouver
Victoria

Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Sixth of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the

PARLIAMENT BUILDINGS, EDMONTON.

This building was wired with "Adanac" Rubber Insulated Wire.

Architect, A. M. Jeffers, Edmonton.
Engineer, James McAlear, Chicago.
Electrical Contractors, Cunningham Electric Co., Calgary.

Address enquiries to nearest office

Northern Electric Company
LIMITED

Montreal
Halifax
Toronto
Winnipeg
Regina
Calgary
Edmonton
Vancouver
Victoria

Successors to
Imperial Wire and Cable Co., Limited.

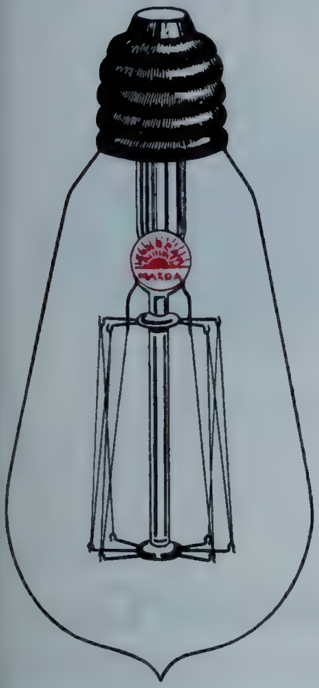
Correspondence previously addressed to the Imperial Wire & Cable Co., Limited, at 611 C.P.R. Building, Toronto, and 902 Electric Railway Chambers, Winnipeg, should now be addressed to Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave. West, Winnipeg.

Mr. Carbon Lamp User

You exercise great care in selecting machines for your plant—why not do so in selecting your electric lamps?

SUNBEAM

Drawn Wire **Mazda Lamps**



are an investment that pays big dividends in the form of three times the light at the same cost or the same light at one-third the cost.

And their ruggedness assures long service—they burn equally well in any position and are not affected by vibration. They do not discolor or give less light with age.

Start cutting lighting costs now. Put a Sunbeam Mazda Lamp in every socket.

We ship quickly.

The Canadian Sunbeam Lamp Co., Limited

Main Office and Factory: TORONTO

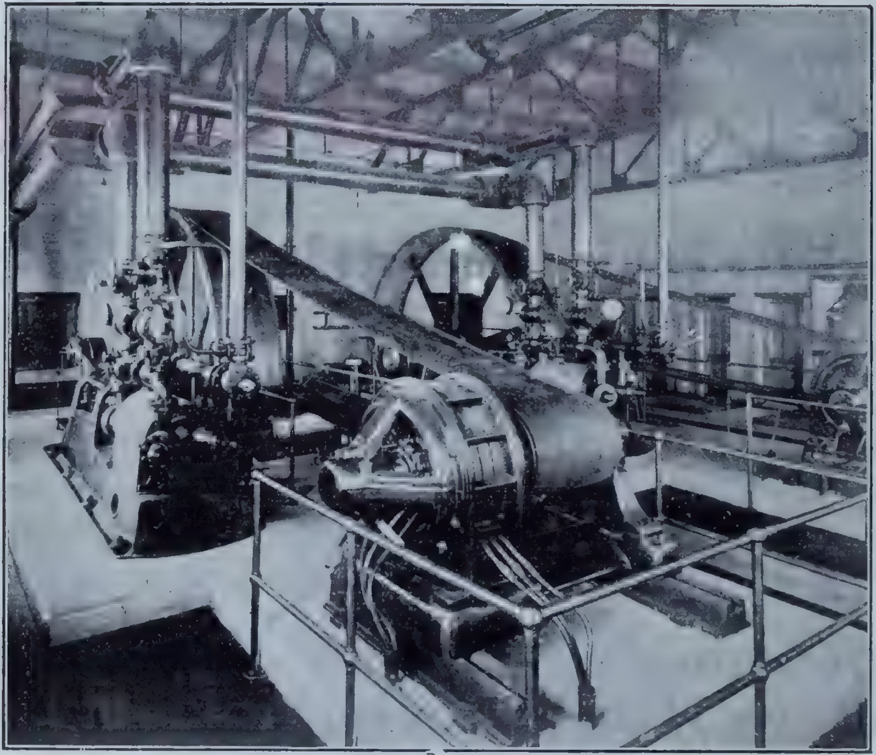
Branch Warehouses; MONTREAL WINNIPEG CALGARY VANCOUVER

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogues and estimates upon request.

The Linde Canadian Refrigeration Co.,

Limited

37 ST. PETER STREET, MONTREAL

Branch Offices—Toronto, 23 Scott St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, Tegler Building; Calgary, 407 P. Burns Building.

McDANIEL IMPROVED **STEAM TRAP**

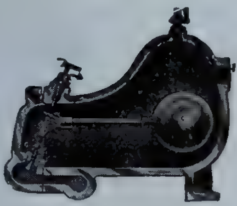
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.



EXCELSIOR
ANHYDROUS
AMMONIA

On request we will furnish free to engineers of refrigerating plants a book of interesting facts on refrigeration, which also contains sensitive paper for detecting ammonia leaks.

Canadian Ammonia Co., Ltd.
TORONTO, ONT. DETROIT, MICH.

ertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive.

Ice Making and Refrigerating Machinery

Established 1867

Built in any capacity that you desire.

Our small machines have the same "Regularity of Operation," "Reliability" and "Efficiency" as our large ones.

Write us concerning the size you wish.

The Vilter Mfg. Co.
242 Becher Street,
Milwaukee, Wis.
Chicago Office: 731 Monadnock Bldg.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration.

De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name De La Vergne stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

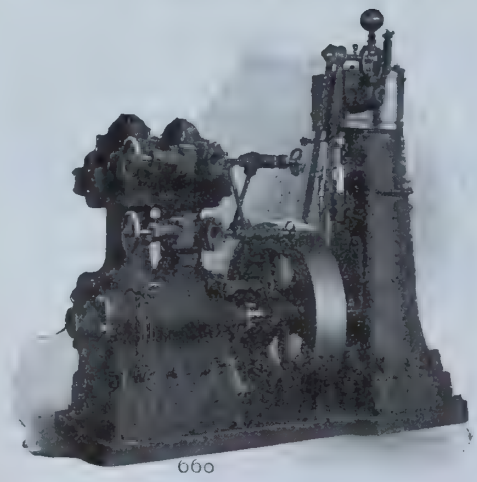
Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada

If You Could Reduce Your Cost of Refrigeration



Think what it would mean! Increased profits—principally. But **Mechanical Refrigeration** will do more than increase your profits. It is more sanitary, more reliable, and in every way more satisfactory.

YORK Vertical Enclosed Refrigerating Machines are self-contained, easy to handle, and do not require a skilled operator.

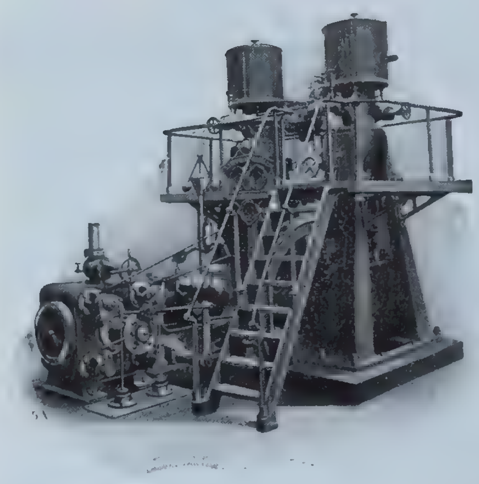
½-ton Refrigerating Capacity and upwards.

We are just entering upon the season when you will feel the need of Mechanical Refrigeration most. Why not install a plant at once?

Write us for prices and information.

YORK MANUFACTURING COMPANY, YORK, Pa., U. S. A.
Ice-Making and Refrigerating Machinery Exclusively

Represented in the Dominion by
CANADIAN ICE MACHINE COMPANY
MONTREAL, 324 Coristine Bldg.
TORONTO, 163-167 Yonge Street
WINNIPEG, 302 Donalda Bldg.



Durability is Reliability

Durability saves costs of repairing.
Reliability saves costs of accidents.
Both save costs due to shutdowns.

To have the peace of mind and confidence that the owner of a **FRICK** Machine enjoys during the rush season in midsummer you must be the owner of a **FRICK Machine.**

It costs a little more, but it's cheapest in the end.

It is built with but one aim in view—to make it as durable and reliable as a refrigerating machine can be made. If a weakness develops in the smallest part it is immediately removed—no part is left to chance. Every part is made very heavy and the best materials known are used in its construction.

The result—a machine having the highest degree of durability and reliability—the best for its purpose—the cheapest and safest.

Canadian Representatives:
Keith's Limited
297 Campbell Ave. Toronto

FRICK COMPANY
Waynesboro, Pa., U. S. A.

J. V. Jamison, President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

Change of Name

On and after September 1st, 1914

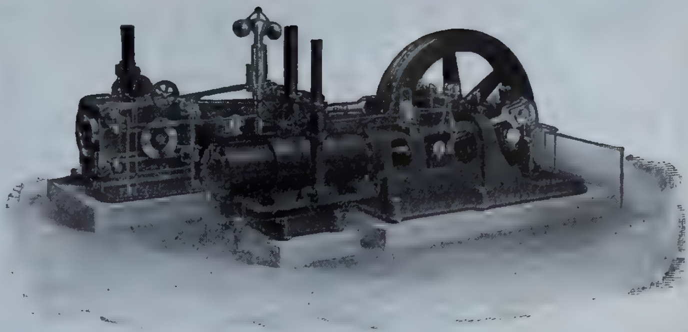
Jones Cold Store Door Co.

will change its corporate name and will thereafter be known as—

The Jamison Cold Storage Door Company

HAGERSTOWN, MARYLAND

No change whatever will be made in the organization or the business of the Company. The personnel of the management and the sales and shop force will be the same as it has been since 1907.



Arctic Ice Machines
in Canada

are creating sales wherever installed. Recently we placed in operation an Arctic Refrigerating Plant for the St. Regis Hotel, Winnipeg.

Next the St. Charles Hotel, Winnipeg, ordered a similar outfit.

We are now shipping an Arctic ice and refrigerating plant to the new Olympia Hotel, Winnipeg.

In ice factories, storage houses, etc., we can point to the same occurrence.

When an ice machine is its own best salesman—well, you want that kind.

Sizes from one-ton refrigeration upward.

Bulletin 1-P on request.

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

THE H&C SAFETY

The Largest Ice Dealer in Detroit Installed Two H. & C. Safetys a Year Ago.

Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of 6 3-10 K.W. **per ton or more than 11½% saving in power consumption.**

You, Mr. Iceman, should check up on your costs and capacity against these records.

Write us to-day for a Pittmans & Dean chart of their year's results.

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Refrigerating and Ice-Making Machinery
DETROIT 42nd Year. MICHIGAN

SIMPLEX SPECIALTIES

SIMPLEX VALVE

PATENT RESEATER

Simplest Machine on Market.

All Sizes up to 15".

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Self-Centering Visible Cutters

A necessity in an up-to-date Power Plant.

Faces Valves with Flat or Angled Seats

SIMPLEX No. 2 SELF-ADJUSTING FLUE CLEANER

GEO. H. TOD	TORONTO
GEO. H. TOD CO.	WINNIPEG
WESTERN SUPPLY & EQUIPMENT CO., Ltd.	CALGARY
W. POOLE DRYER CO., Ltd.	VANCOUVER
MAYSMITH & LOWE Ltd.	VICTORIA

BROMELL PATENTS CO., Ltd., Glasgow, Scotland

BOILER SETTING

B OILERS properly set, re-set and repaired.

O UR staff are experts in firebrick masonry.

I NSTALLATION which means efficiency.

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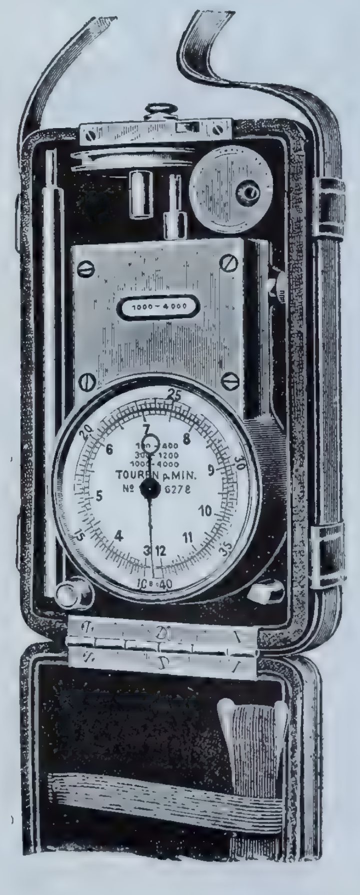

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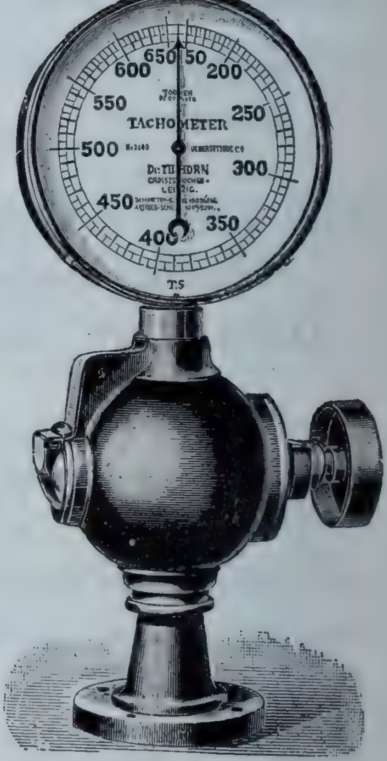

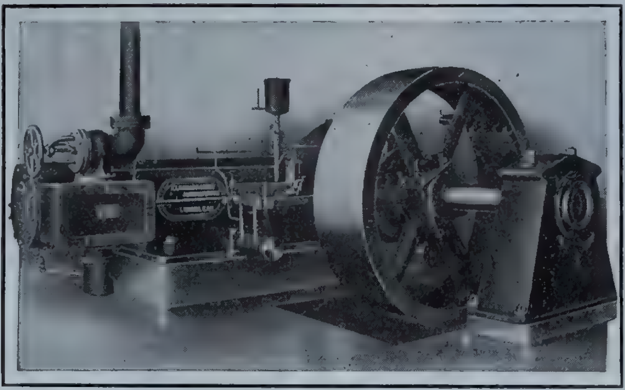

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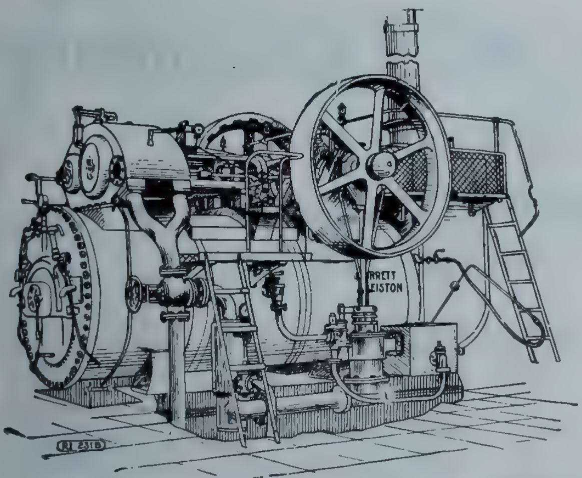

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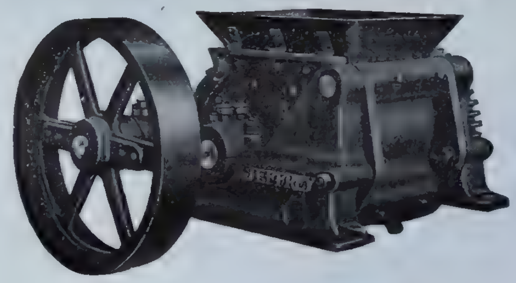

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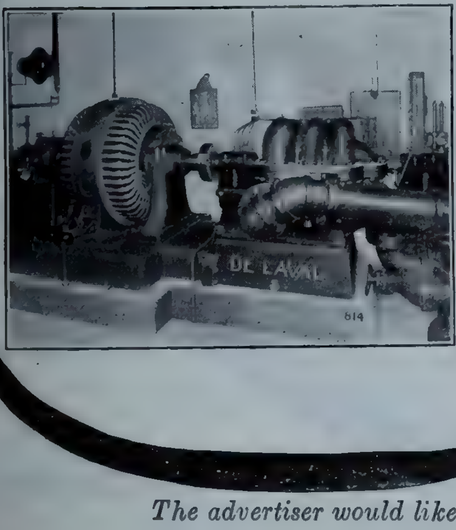

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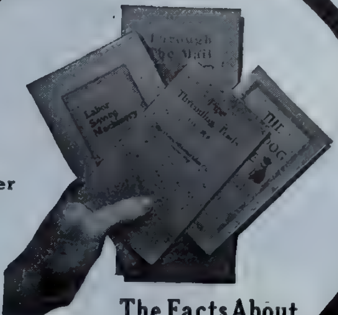

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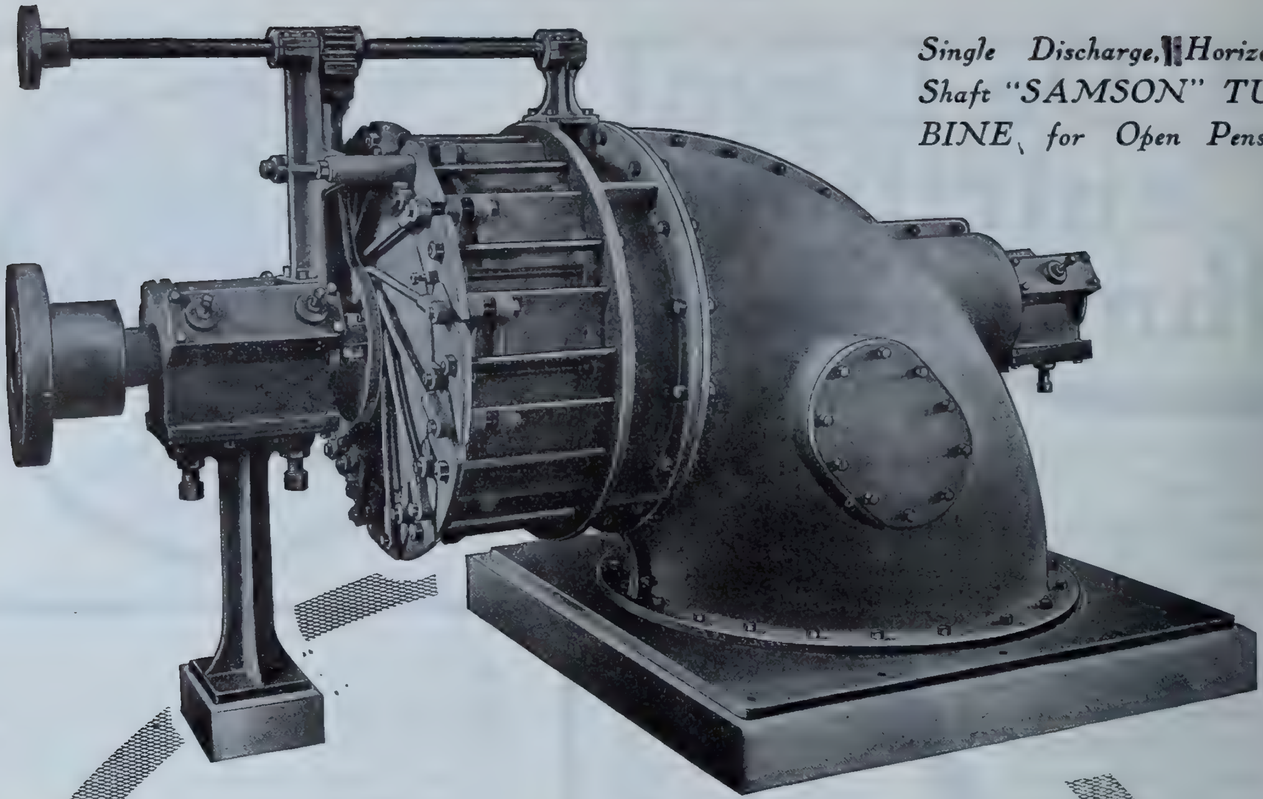

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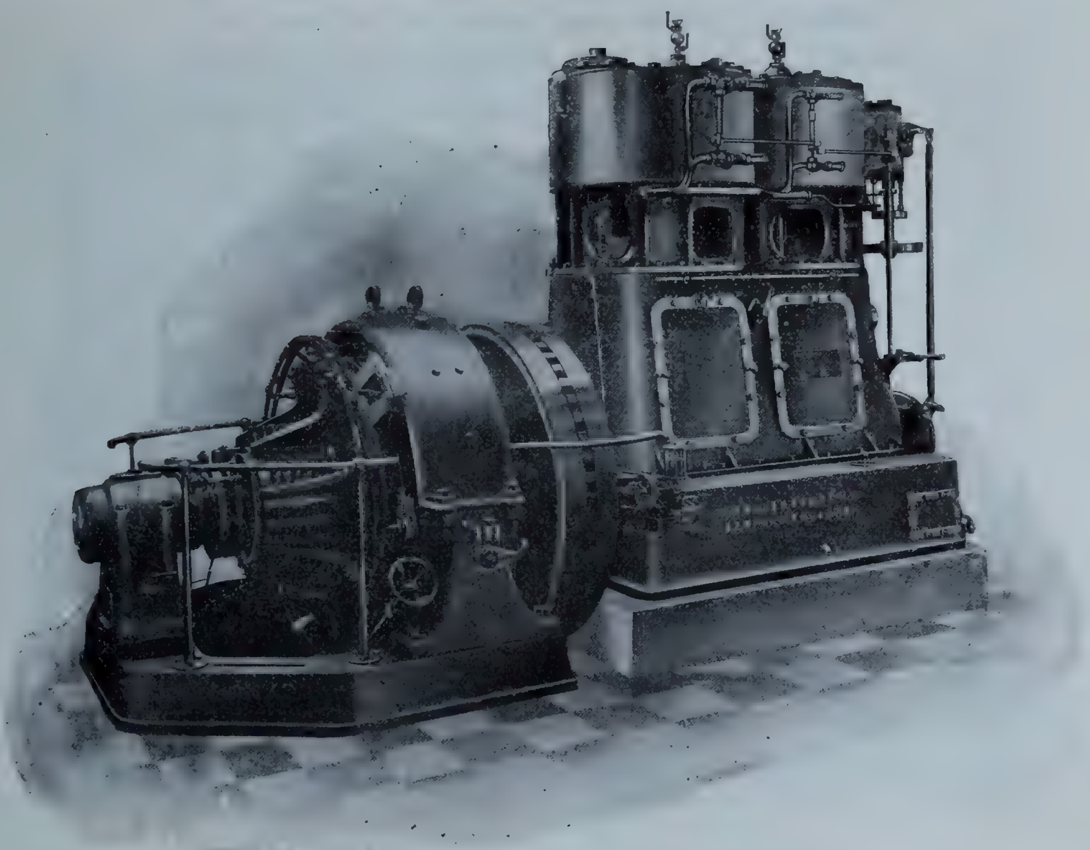

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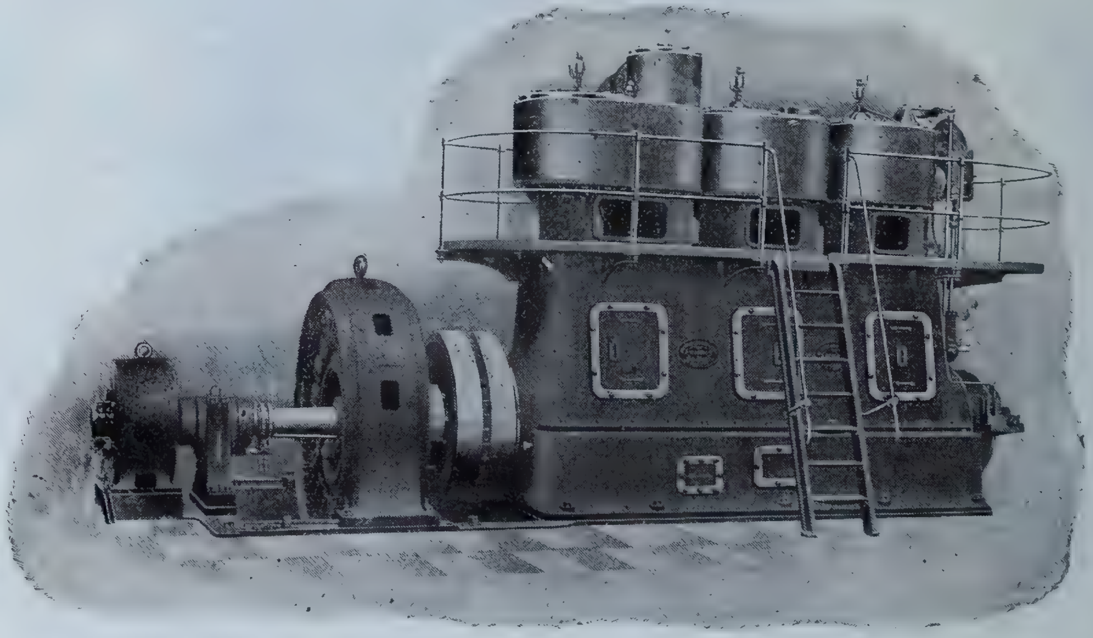

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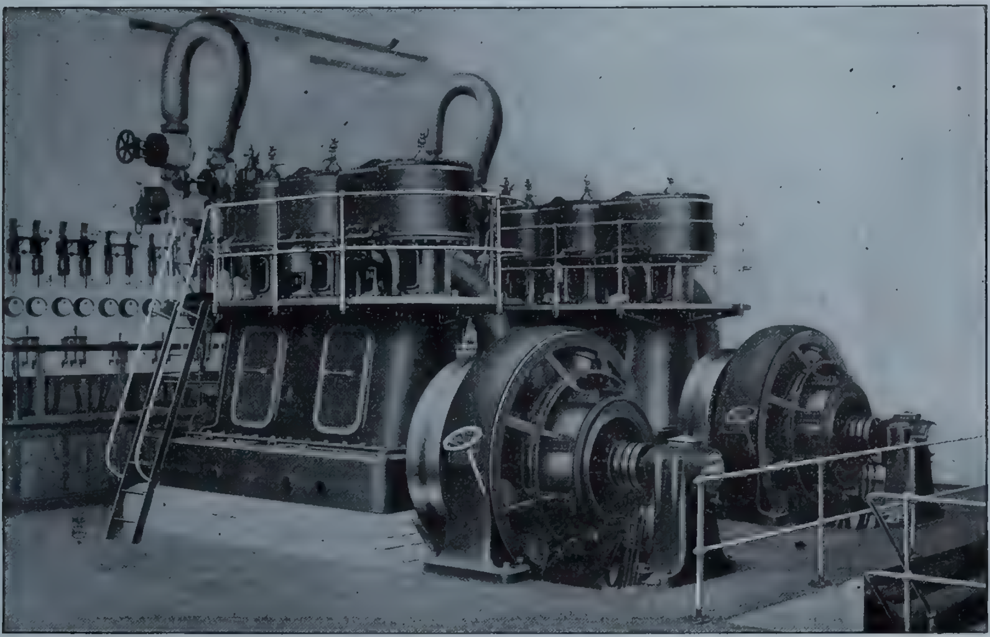

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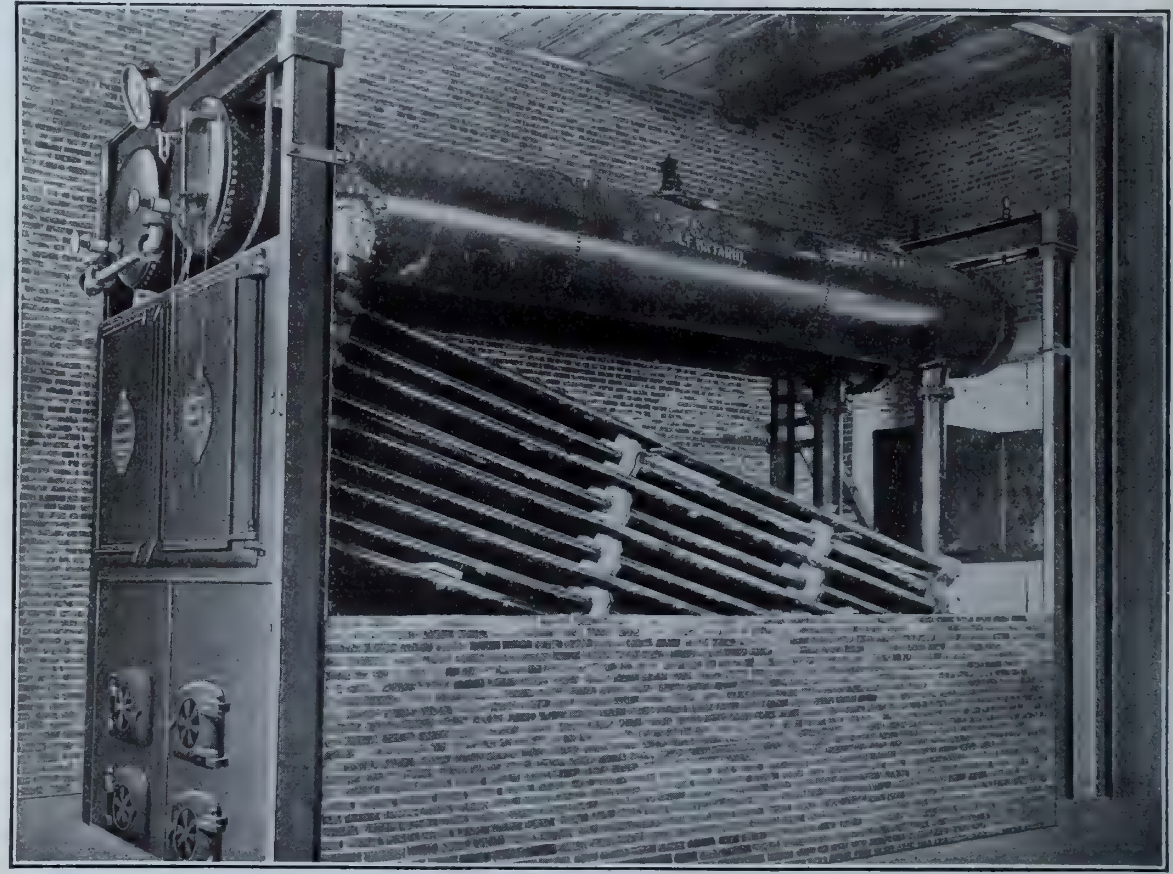

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Boiler Room Efficiency and Task Setting for Firemen*

By Walter N. Polakov

The object of the accompanying paper is to outline a method for the accurate determination and permanent attainment of maximum economy in daily boiler-room practice by the task-setting method. The problem involves a knowledge of the conditions under which maximum operating economy can be obtained and the determination of the factors which will secure the permanency of these best conditions.

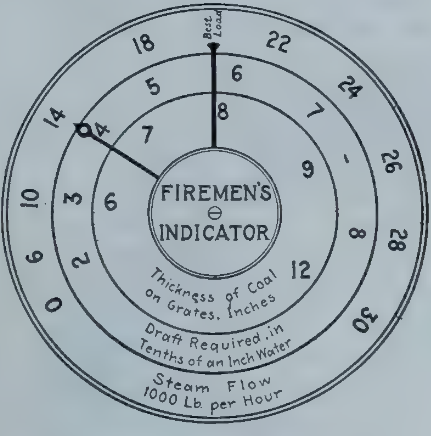
THE writer recently had an opportunity to reorganize the power plant of a large public utility company, and the methods employed to determine the tasks for the firemen and to attain the improvement in results which they represent in everyday running met with such success that a report on the subject seems to be warranted.

The engineering function of a boiler plant is deliberately to convert the thermochemical energy latent in fuel into the volume energy latent in steam, through a process of trans-power, while the commercial function is to generate steam of required quality and in a required quantity at the lowest cost compatible with the circumstances. The problem before the management, however, is to determine and provide the necessary and sufficient conditions, the fulfilment of which will bring about and assure the permanency of the desired predetermined results.

Factors Contributing to Boiler Plant Perfection.

The degree of engineering perfection in a boiler plant is generally reckoned in terms of thermodynamic efficiency, but this criterion alone is both inaccurate and insufficient. It is inaccurate, inasmuch as the inherent thermodynamic efficiency of the plant, if determined either by calculation or by experiment under ideal conditions, is not attained in practice; if determined from everyday performance it is short by some unknown quantity, depending upon the variable "human element." It is insufficient since the conception of thermodynamic efficiency of a boiler plant does not include the "time element" which is the chief determining factor in our industrial, commercial and social lives. Thus, the thermodynamic efficiency can represent correctly the degree of perfection of the whole plant only if supplemented by correction factors taking into account the human and time elements, and is only one of many factors to be considered in the problem of reckoning the industrial efficiency of a plant.

As in differential calculus, the place of maxima depends upon the limiting conditions of variables and constants, so in our problem the proper and complete solution can be found only by strict observance of the rules of scientific investigation, and the steps to be taken in this research work can be grouped chiefly as follows:—


Best Load
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Thickness of Coal on Grates, Inches
Draft Required in Tenths of an Inch Water
Steam Flow 1000 Lb. per Hour
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6
10
14
18
22
24
26
28
30
2
3
4
5
6
7
8
9
12
6
7
8

FIG. 1. STEAM FLOW METER DIAL.

(a)—Analysis of elements.

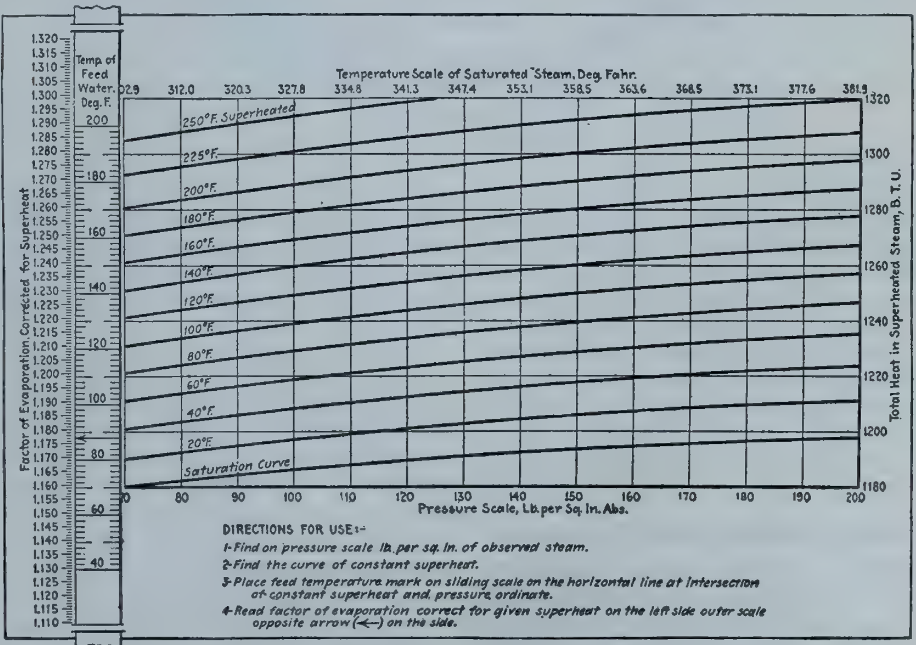
(b)—Study of limiting effects of variable and constant elements on the maximum efficiency of partial processes.

(c)—Determination of maximum effect and the co-relation of determining factors. When in this manner we learn what can be accomplished and what are the conditions **necessary** for it, we have further to investigate whether these conditions are **sufficient**. Our knowledge would be insufficient if we did not consider the element of human will to attain the task set, and the stimulating factor to keep permanently at work the power of will to maintain these known favorable conditions.

The well-known fact that the high thermal efficiency attained by experts during the boiler tests is seldom maintained in everyday practice is due to gross neglect on the part of the management to record the conditions causing the high efficiency during the test; to instruct the men how to regulate these conditions in order to duplicate the test results, and to provide an incentive to the men to strive for the purpose desired by the management or owners. To this we may add that in most instances there is no assurance or proof that the high test efficiency was really the highest attainable.

Efficiency Testing of Steam Boilers.

The work of testing steam boilers as it is usually conducted is not infrequently done by young college graduates or sometimes by the boiler-room force, even in the plants of conservative and reputable companies. The data thus obtained is seldom reliable and complete, and even if every factor, however insignificant, is measured and recorded the results are almost equally worthless, except that occasionally such tests dis-



DIRECTIONS FOR USE:—

1—Find on pressure scale lb. per sq. in. of observed steam.

2—Find the curve of constant superheat.

3—Place feed temperature mark on sliding scale on the horizontal line at intersection of constant superheat and pressure ordinate.

4—Read factor of evaporation correct for given superheat on the left side outer scale opposite arrow (←) on the side.

FIG. 2. SLIDE RULE FOR DETERMINATION OF FACTORS OF CORRECTION.

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*From a paper read recently before the American Society of Mechanical Engineers.

close a serious leak somewhere and enable steps to be taken to remedy the isolated cause of loss. As a rule these evaporative tests are of no further use than to satisfy the owner's curiosity or fancy to see mere figures of efficiency and load and sometimes heat balance. As a consequence, the work of testing boilers has been brought in to disrepute, and auxiliary to a "selling trick."

A mere heat balance is unable to furnish answers to the many questions of utmost importance for determining conditions for the most economic steam generation. Lack of positive, well-grounded principles as well is responsible repeatedly for faulty construction of furnaces and arrangement of baffles and gas passages. The average data of most tests are of very little value, inasmuch as such factors as attention and skill of firemen are dumped into the same heap with the factors of boiler and furnace construction, and of properties of fuel. Furthermore, the most reliable test data are of very limited practical value unless they are so analyzed that the dependence of certain phenomena upon definite factors is clearly revealed.

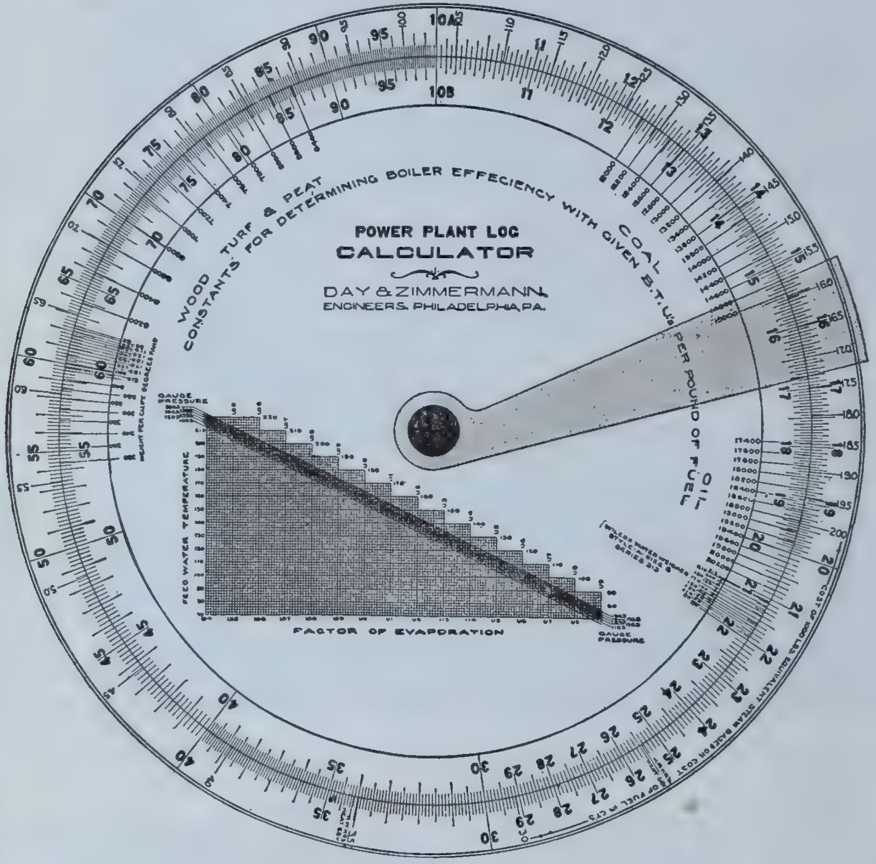


FIG. 3. POWER PLANT LOG CALCULATOR.

Graphical Study of Boiler Performance.

What is needed most is a method of boiler test research which will establish a theoretical standard for each partial process and allow the determination of partial and ultimate efficiency, and also establish the influence of such conditions as variation of specific heat of gases depending upon their composition and temperature, radiation of furnace, variation of efficiency of heat transmission, variation of volume of gases in passages with different conditions of combustion, various rates of firing and percentage of infiltration of air, and influence of superheat on the economy of the process. The graphical method of studying boiler performance, as suggested several years ago by Professor Grinevetski, fairly satisfies these requirements, and the diagrams thus obtained, representing the working process of a steam boiler, are the most reliable tools in the hands of an investigator for setting the task for boiler operation independent of the skill of the casual firemen during the test, and plainly establishing the relation between the causes and effects.

The Grinevetski method of graphical analysis is one that is particularly useful in showing the inter-relations of these important governing variables of the steam boiler. By it the relations between the temperatures of the gases and the heat contained in them at various temperatures are shown in the form of parabolic curves, as are similarly the relations between the heat in the gases and the area of heating surface, and also the relations of radiated heat to the heating surface.

Graphical Analysis Test.

A development of this method of analysis is shown in a series of tests made at the Warrior Ridge power plant of the Penn. Central Light & Power Co., and its application to practice, as outlined in the following paragraphs, is virtually the basis of the method of work discussed in this paper. Tests Nos. 1 and 2 were for the purpose of ascertaining the economic result of the operating method in vogue at the plant before betterment work was started, and to determine any possible weaknesses of the practice.

Test No. 1 is merely a record of observations made over a period of eighty days to determine the result of former operating conditions, while test No. 2 was a deliberate attempt to make a favorable showing under those conditions. The efficiency observed in test No. 2 was 67.94 per cent. Tests Nos, 3, 5 and 6 were run to study the effects of the various changes made in operating conditions and for the standardization of practice, while test No. 6 was a check test on our standard conditions. It showed the efficiency of boilers, furnaces and grates as 76.03 per cent. when operating at 89.6 per cent. of rating, while its official repetition under a load of 115.5 per cent. of rating showed an efficiency of 77.66 per cent. Tests Nos. 8, 10a and 10b were made principally for the selection of coal.

The advantages of graphical study of boiler performance were thus plainly demonstrated, and the efficiency figure of 77.66 per cent. was accepted as a practical maximum of thermal efficiency for this boiler, furnace and grate. As a method, it demonstrates with an appealing clearness the main conditions and results of the process of combustion and steam generation. As a matter of fact, the characteristic curve does not change materially in shape for different boilers, nor vary at all for the same boiler and same fuel, and thus the problem resolves itself into mere calculation of scales, shifting of co-ordinates and measurement of projections.

Low Limit of Fireman's Efficiency.

The next question, therefore, was to ascertain what would be the reasonable limit below which no fireman should allow his efficiency to drop. In this we had to consider the factors beyond the control of firemen; viz., sudden fluctuation of load and unpracticability in that particular instance to analyze gases every three minutes; drop of attention every forty minutes for the period of eleven to twenty minutes and effect of cooling off heating surface and furnace walls during the cleaning of fires (the allotted time for this was set on time studies as eighteen minutes per 100 square feet of grate surface). On the other hand, there was made a correction for blowing off the boiler once every twenty-four hours, which credited the boiler with so much metered water and debited it with so many heat units in the same amount of water at the boiler temperature. As a result of these investigations and studies, it was found that the standard for the task should be set at 70 per cent. combined boiler and grate efficiency.

In this connection it is interesting to note that all officials of the concern and the representative of the boiler maker considered the task on this basis too high, and that accomplishment of it would be out of the question. The only argument that obtained its temporary approval was that it was easier to reduce the task in the future if not feasible to accomplish than to make it higher. The fourth month of the task work, however, proved that 73.1 per cent. of boiler and grate efficiency was permanently maintained, effecting for the company a gross saving of approximately 25 per cent. on the fuel bill alone. This was accomplished, and we would like to emphasize the fact, without heavy capital investment for physical improvement of equipment like automatic stokers, special grates, force draft fans, soot blowers, etc., the only expense being for a few instruments for the guidance of the firemen in their work of living up to their instruction card.

Boiler Output Meter Requirement.

After the test results were carefully studied and the practical maximum efficiency established, it was an easy matter, by referring to the test logs, to standardize the conditions of firing which necessarily result in generating steam at a desired degree of efficiency. In this, however, difficulty was encountered in that, like the great majority of boiler plants, these boilers were equipped with only pressure gauges and water columns, and it was necessary to provide instruments for certain important measurements.

As with other conditions equal, the weight of steam is in direct proportion to the weight of fuel burned, the first instrument necessary for informing the firemen as to how much coal to put in the furnace is a meter indicating the output of the boiler; but as this proportion is constant only at a given condition of combustion, the firemen have to be informed at all times as to what these conditions are. Since complete combustion requires a strictly defined quantity of air per pound of fuel of given composition we have to know the composition of the fuel; the rate of firing in lbs. per sq. ft. per min.; and the rate of air supply in lbs. per sq. ft. per minute.

In most cases, it is possible to obtain fuel of practically uniform analysis, and, in addition, to have the analysis report within three hours from the time of the delivery of the coal to the bin, so that the first variable may be taken as a constant. As to the rate of firing, this is indicated by the steam flow meter, inasmuch as conditions of combustion are uniform. Then, our last variable, the quantity of air to be supplied per minute to the furnace, is the factor which we have to control.

Furnace Air Supply Control.

As long as the infiltration of air remains constant (it should be as near to zero as possible), and the cross-section of air ducts or pit doors is constant, the variable elements are the velocity of air and its specific weight. The specific weight being a function of temperature, calls probably for not more than two corrections per year for winter and summer average temperatures in the fireroom. Thus, we have a practical solution of the problem in the indications of a draft gauge. Draft, i.e. vacuum over fires, is usually measured in such small fractions of an inch of water column that, considering the resistance of flow of the gases through the boiler as constant for each rate of firing, it is more convenient to take readings at the uptake. From our definition of the draft as vacuum, it follows that, in itself, it is no indication as to quantity of air flowing through the fuel bed, and must always be considered in relation to the resistance offered by the layer of burning coal. Careful tests can easily establish the desired inter-relation between the quantity of air and thickness of fires, or a duplex draft gauge can be advantageously used.

Instruments for Fireman's Guidance.

This reasoning leads to the conclusion that, for practical guidance the fireman needs at least three instruments:—

a.—Indicating steam meter.

b.—Draft gauge.

c.—Indicator for the co-ordination of the condition of firing with the load carried by the boiler at any moment.

In his experience, the writer found that the well-known General Electric steam flow meter of the indicating type could easily and satisfactorily serve the third-mentioned purpose. The writer arranges on the dial of the steam flow meter an inside dial, as shown in Fig. 1 with numbers indicating the required thickness of fuel bed corresponding to the number of pounds of steam drawn from the boiler and a third dial with numbers indicating the draft which is necessary and sufficient to supply the required quantity of air for the combustion at a rate called for by the indicated steam demand. Thus, if the pointer, as in Fig. 1, shows that steam is flowing from the boiler at a rate of say 14,000 lbs. per hour, the fireman will know that the figure 4 under the pointer on the middle scale means that a draft of 0.4 in. of water is needed, and that the location of the pointer on the inner scale between the figures 6 and 7 calls for a thickness of fires of from 6 to 7 inches.

Providing Against Engine Crankshaft Troubles

From "Vulcan"

There is here discussed the various contributory causes from which arise crankshaft troubles in steam, gas and oil engines, together with observations on the means that should be adopted to minimize their effects, and if possible, wholly prevent them.

THE crankshafts of steam, gas, and oil engines may be designed from calculations to withstand certain stresses, but their durability depends on many circumstances connected with their construction and usage, which cannot be calculated and allowed for. The shaft that is least liable to these disturbing factors is that having an overhanging crank and two bearings with the flywheel between. If such a shaft be made with a moderate margin of safety and the bearings receive ordinary care, it will usually last the whole lifetime of the engine; but if a third bearing be introduced, say, somewhere about the middle, the life of the shaft becomes uncertain and an early breakage may be expected unless the utmost care is taken to keep all three bearings perfectly level and in line. The breakage of the crankshafts of gas and oil engines is one of the perplexing problems which users of these prime movers have to face, as these shafts are invariably machined out of single forgings, expensive to manufacture, particularly when there are several cranks on the same shaft.

Fractures Due to Forging Processes.

Sometimes a solid shaft with only one crank and two bearings will, for no apparent reason, develop serious fractures in the webs. Such fractures obviously cannot be due to the bearings getting out of level, because as there are only two bearings it is immaterial whether they are absolutely level or not. Such fractures, apparently, are due to the process adopted in forging the crank. To shape out the two round portions of the shaft on either side of the crank the metal has to be hammered or pressed from one side of the ingot to the other, with the result that permanent stresses are left in the metal on the outer faces of the crank and, when the crank is put to work, the vibration due to working intensifies these stresses; and their repeated application eventually fatigues the metal and leads to fracture.

Maintaining Bearing Alignment.

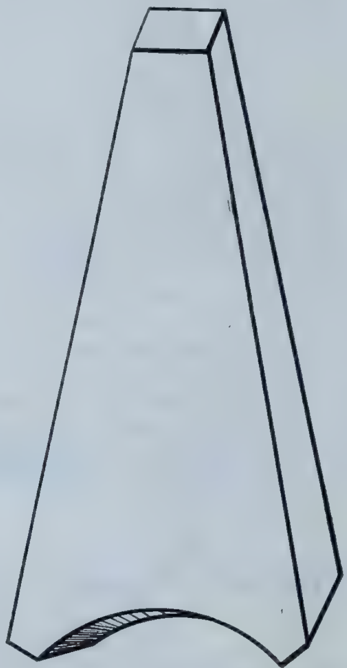
To guard against fractures of the kind just described is often beyond the care of engineers once the shaft is made, but owners of engines which have shafts supported on three or more bearings should be careful to see that the bearings are maintained absolutely level and in line. It may be that when the engine is erected the shaft is dead level, and each bearing taking its due proportion of the weight, but it is difficult to maintain these levels, especially in the inverted vertical marine type of steam engines, horizontal gas engines, and in vertical Diesel engines. Several causes operate to produce changes in level; the most prolific being settlement of the foundations, destruction by oil of the upper surface of the cement work, and wear of bearings, particularly when the brasses are lined with white metal. Where heavy flywheels are in use settlement may be looked for in the bearings nearest the wheels. It is found in the case of gas engines where three bearings are in use that frequently the whole engine frame will tilt on the side nearest the flywheel.

Testing Bearing Alignment.

The testing of crankshaft bearings for level and alignment requires considerable skill. It is not sufficient to lay a spirit-level on the flywheel shaft and assume the bearings are level because the shaft shows no discrepancy. A shaft may be stiff enough to take the weight of the flywheel when not working without appreciable deflection, and yet it may bend considerably when working if the middle bearing is too low. The safest way, therefore, after jacking up the shaft and making it level for its entire length up to its highest bearing (taking care to see that the sag or deflection of the shaft, if any, is eased up) is to try the bottom brasses for slackness. If there is any play they must be too low by that amount. If it be a gas engine with three or more bearings, the engine bedplate or frame should be tried for cross level on some machined part and, if it has tilted, the frame should be restored to its correct level by picking out all decayed cement work and driving sheet steel under the entire surface of the frame where in contact with the foundations. It is not always convenient to do this, however, and lining up the brasses may be preferable. In such cases the liners should be soldered to the back of the brasses. Whilst referring to gas engines, it may be mentioned that a rough and ready test of the level of the shaft may be made by dropping a plumb-line alongside the rim of the flywheel which is always turned, and should therefore be true if it is keyed true on the shaft.

Sinking of Engine Bedplates.

The sinking and tilting of engine bedplates or frames in steam engines is a point that should be carefully guarded against, as not only have many shafts broken from this cause but many an engine-frame has been broken as a result of the foundations on which it rested becoming softened in some places whilst remaining firm in others. Similar treatment to that described for gas and oil engines should be applied to put defects right, though in many cases where stones are used as a top layer, folding wedges and Fox's cement have to be applied in the joints of the masonry under the stones.


CRANKSHAFT LEVELLING PROPS.

The sinking of bedplates in rolling-mill engines is very common, and as the shafts in the majority of such engines are of the "sweep" type, very accurate tests can be made of the levels not only by the spirit-level, but by gauging the inner faces of the crank webs in two vertical positions with the crankpin at top and at bottom. If the bearings have sunk, the space will open and close by the bending of the crank-pin and the gauging will show a difference of lengths.

In the case of inverted vertical marine steam engines and vertical oil and gas engines a difference in the level of the bearings generally occurs at the tail end of the shaft on which the flywheel, frequently of large diameter and considerable weight, is keyed. The bedplate of the engine is always bolted down to a solid block of masonry, and there is a gap for the flywheel followed by an outer bearing. This latter bearing often rests in a wall box or on a narrow pillar of masonry, consequently it has a greater tendency to settle than the block that carries the engine proper. In addition to trying such a shaft by a spirit-level or the side of the flywheel by a plumb-line the bolts of the coupling, if there is one between the tail shaft and the engine crank or cranks, should be knocked out and feelers inserted between the flanges of the couplings, when it will be readily seen whether the space will take different thicknesses at opposite sides of the coupling. If different thickness can be inserted the shaft must be out of level, owing to a difference in the level of the bearings, which can easily be rectified, as frequently it only means adjusting the outer bearing.

In some instances it may be difficult to apply a spirit-level to a shaft owing to want of room. This may be overcome by making wood props shaped like the cut herewith, the concave portion extending about one-third the circumference of the shaft and being shaped to the exact circle. The top should be slightly wider than the width of the spirit-level. Two or more such props may be placed vertically on the shaft in convenient positions between the eccentrics, pulleys, wheels, etc. With such props to clear wheel bosses and other obstructions, the levels of a shaft can be taken by applying a straight-edge and level to the tops of the props. As the places on the shaft where the props rest will be frequently of different diameters, such differences will have to be allowed for so as to make the upper surfaces of the props equi-distant from the center line of the shaft.

* * *

Regina Engineering Society. — The Regina Engineering Society executive for the present year is as follows: — President, H. S. Carpenter, Board of Highway Commissioners, Saskatchewan Government, Regina; first vice-president, L. A. Thornton, city commissioner, Regina; second vice-president, R. O. Wynne-Roberts, consulting engineer, City Hall, Regina; secretary, J. M. Mackay, superintendent of waterworks, Regina; treasurer, R. N. Blackburn, chief boiler inspector, Saskatchewan Government, Regina.

Power Plant, Matthews, Blackwell, Ltd., Toronto

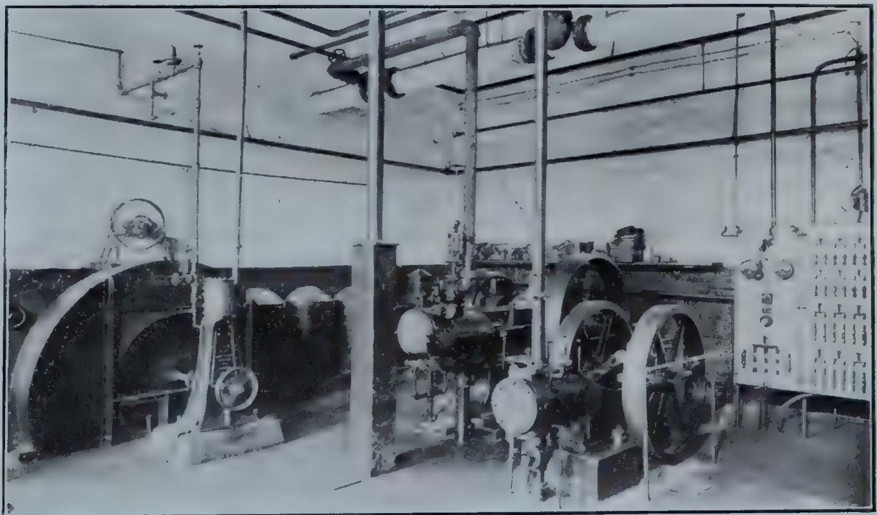
Staff Article

The modern packing house demands of equipment manufacturers their most up-to-date, reliable and efficient-in-service product, and one has only to peruse the accompanying or similar articles which appear in our columns from time to time to appreciate the truth of this statement.

AT the packing house of Matthews, Blackwell, Ltd., Toronto, a number of interesting features are to be noted. In this article, however, we will confine our observations to a description of the power plant only, this particular department being well equipped, and, according to Mr. Bannam, the chief engineer, the various units are giving highly satisfactory service. The plant is admirably situated near the railway tracks, which run alongside, offering every facility for the shipping of hogs to the packing plant, and coal for the boiler-room.

Boiler and Stoker Installation.

The boiler installation consists of four return tubular boilers, three being 66 in. diameter by 16 ft. long, supplied by the Goldie, McCulloch Co., Galt, and the Bertram Co., Toronto, while the fourth is 72 in. diameter by 18 ft. long, and was supplied by the Berg Machinery Co., Toronto. Each boiler is equipped with a mechanical stoker, installed by the Jones Underfeed Stoker Co., Toronto, and in connection with the installation is a 110-in. three-quarter-housed steel plate special "Sheldon" fan direct-connected to an American Blower Co., 5-in. x 5-in. vertical steam engine. The fan is located in the engine-room, and so arranged that it is directly in line with the stokers. It runs at a maximum speed of 500 r.p.m., but when under control of the regulating valve, the speed is reduced to 100 r.p.m., at which speed the fuel feed is automatically cut off, the operating mechanism of the stokers being directly connected to the fan. The main air duct from the fan is 25 in. diameter, with 14 in. diameter branches to each boiler. The ducts are made of galvanized steel plate, protected by concrete. The steam pressure of 100 pounds in the boiler is controlled and maintained by means of a 1¼-in. "Mueller" regulating valve, which operates within a range of from 2 to 3 pounds' variation of boiler pressure, and automatically reduces the speed of the fan and amount of coal feed when boiler pressure is normal.



STOKER FAN, GENERATING SET AND COMPRESSOR.

A brief description of the operation of the stoker may be of interest. The coal is placed in the hopper and automatically pushed into the green fuel bed under the fire, where it is subjected to a coking effect until it, in its turn, is forced to the top. Each charge of fuel causes a backward and upward movement that keeps the top of the fire constantly agitated without opening fire doors. Air for combustion is admitted between the green fuel and the fire bed. The steam pressure itself automatically controls the fuel and air supply, proportioning them to each other and to varying loads, in amount to obtain most complete combustion possible from any grade of bituminous coal. As grates form no part of the "Jones" system, loss of fuel through grate bars is impossible. The stoker mechanism operates at a comparatively low speed, making approximately one stroke every two minutes, and feeding about 15 pounds of coal at each stroke.

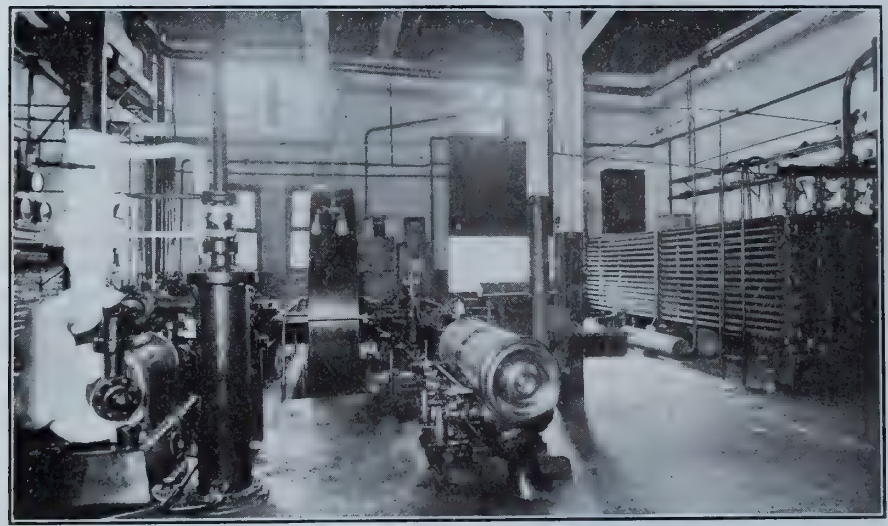
BOILER AND STOKER INSTALLATION.

Ammonia Compressors.

The engine-room is divided into two sections. In the main section is installed a 90-ton ammonia compressor, supplied by the Linde-Canadian Refrigeration Co., Montreal, and direct-connected to a 225-h.p. Goldie & McCulloch "Wheelock" 17 in. by 38 in. engine, running at 70 r.p.m. This unit is of sufficient capacity to take care of the entire cold storage plant, which comprises twenty-four rooms, eight being freezers, cooled by a direct expansion system and sixteen chill rooms being cooled by an air cooling system. The ammonia condenser for the above unit is located in the engine-room, and is of the double pipe type, consisting of 75 pipes, 8 ft. 6 in. long, arranged in five rows, 15 pipes high. The condenser is supplied with city water by gravity.

In the second section of the engine-room are located the reserve ammonia machine and lighting plant. A 200-h.p. "Laurie," 15 in. by 36 in. Corliss engine, running at 90 r.p.m., is directly connected to a tandem Linde-British ammonia compressor. This machine is double-ended, and has a capacity of 40 tons for each cylinder, making a total capacity of 80 tons for the unit. The condenser for this machine is of the surface type, and is located on the roof. It consists of four stands of single pipe, 33 ft. long and 24 high. City water is also used for this condenser. A considerable amount of machinery for various purposes is installed. For driving the main shafting there is a 50-k.w. C.G.E. motor, 500 volts, a.c., taking current from the Toronto Electric Co. As a reserve unit there is installed alongside the motor a 40-h.p. Goldie & McCulloch Co. "Wheelock" 10 in. by 24 in. engine.

Returning to the main section of the engine-room, there is installed an 80-h.p. 12 in. by 12 in., "Ideal" engine supplied by the Goldie & McCulloch Co. The engine runs at 270 r.p.m., and is direct-connected to an 80-k.w. C.G.E., 250-volt d.c. generator. This unit supplies current for the entire plant, 250 volts d.c. for the motors, and 110 volts d.c. for the lighting circuit. The switchboard was supplied by the Canadian General Electric Co., Toronto. It has two panels, generator and distributing, and in addition to the usual instruments there is a double-throw switch on the generator panel for connecting up, in case of emergency, with the Toronto Electric Co. lines, supplying current at 250 volts d.c.



AMMONIA COMPRESSOR AND CONDENSER.

Air Compressors and Auxiliaries.

Adjoining the above unit is a Canadian Rand air compressor, having a capacity of 100 cub. ft. of free air per minute against a pressure of 100 pounds. This machine is driven by a 25-h.p. C.G.E. motor, 250 volts d.c. The boiler feed pumps and feed water heater are located in the main engine-room. The pumps are of the "Northey" type, one being 7-4-8 ins., and the other a 7-5-10 ins. outside packed pump. The "Moffat" feed water heater and purifier has a capacity of 200-h.p., and was supplied by the Goldie & McCulloch Co., Galt.

* * *

WORM GEARING.

A PAPER on "Worm Gearing, Its Manufacture," was recently read before the Keighley Engineering Society, by Francis J. Bostock, A.M.I. Mech. E. The author first enumerated the conditions essential to insure successful gears, the relation between the speed, pressure, etc. He then described the earlier methods of making worm gearing, and concluded with a description of modern methods and machines as used in the works of David Brown & Son (Huddersfield), Limited. He said the advent of the motor car had given a great impetus to the worm gear, and in the next few years he anticipated that this form of gearing would be universally used for the final transmission on motor cars.

Features of a Successful Gear.

The author then went on to describe the terms used and the theoretical conditions which have to be fulfilled in order to obtain a successful gear. He said there were many factors entering into the design of worm gearing. The worm angle, for instance, bore an important relation to the efficiency and durability. For many years designers did not realize the importance of having a high lead angle. He said that the maximum efficiency was obtained when the lead angle approximated 43 degs., 40 mins., and that 50 per cent. efficiency obtains when the worm angle is equal to the angle of friction, at which point the worm is non-reversible. The importance of a high worm angle could not be too strongly emphasized. In order to obtain this angle it was necessary to reduce the diameter as much as possible to get a better angle and the minimum of rubbing velocity.

With regard to rubbing velocity and its relation to the pressure area of contact the author contradicted the statement frequently made that the pressure multiplied by the velocity was constant, This, he said, was not so, as it would mean that an increase of velocity would be accompanied by a corresponding decrease of pressure. The lower the velocity, the higher the permissible pressure, and vice versa.

Contact Area.

The next factor referred to was the area in contact. The author said it was often supposed that the whole of the surface was useful. This was not quite so. On the leaving side of the wheel face, the useful part falls off very rapidly from the center; in some cases only 60 per cent. of this side was useful. Again it was possible to get contact over several teeth, which in poorly designed gears was only interference and useless for load-carrying purposes, merely giving rise to frictional losses. There was not always the equivalent of two teeth in contact. There might be contact on portions of three or more teeth, but when projected on to the side view of the wheel this gave only the equivalent of two or less. On an average he might say that 1.4 times the projected area was useful. A finer pitch would give more teeth in contact, but a less projected area, whilst a coarse pitch gave a greater area and a lesser number of teeth in contact, the advantage appearing to be in favor of the latter. The center distance required for the transmission of a certain horse-power at 1,000 revolutions per minute varied approximately as the $\sqrt[4]{}$ ratio and the $\sqrt[5]{}$ h.p.

The amount of heat generated was another factor to be considered. The author said that when the temperature of the gears reached about 250 degs. Fah., the oil film broke down and the lubricating value ceased. This temperature rise was the limiting factor in the capacity of gears. Usually they were run at a temperature of 175 degs. Fah.

* * *

Heavy Duty Corliss Engines.—Canadian Allis-Chalmers, Ltd., Toronto, are distributing a new bulletin No. 1529, devoted to heavy duty Corliss engines. A full description is included.

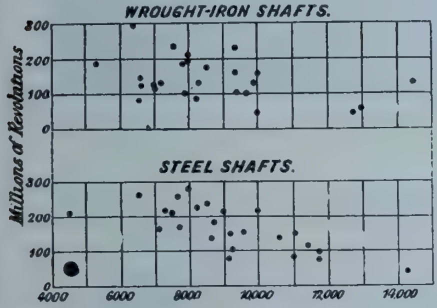
Breakdowns of Stationary Engines, Their Cause and Cure-IV.

By Michael Longridge

The accompanying article, which formed the subject of a recent lecture before the Graduates' Association of the Institution of Mechanical Engineers, is one of special interest to power plant operatives. While this is so, the fact that faulty design and careless installation have played a large part in many "smash-ups," makes the advice relative thereto of considerable value to those also whose work lies in these particular spheres. The author of the paper is the well-known Chief Engineer of a large and leading English power plant equipment insurance company.

THE present is the fourth and concluding article on the subject of stationary engine breakdowns, the part played by crank-shafts being the feature considered.

Crank-Shafts.



FIGS. 24, 25. SHAFT STRESS AND LIFE DIAGRAMS.

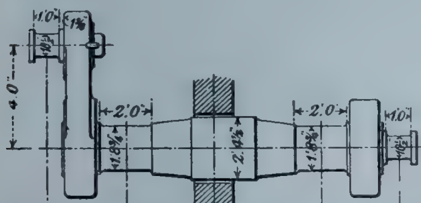
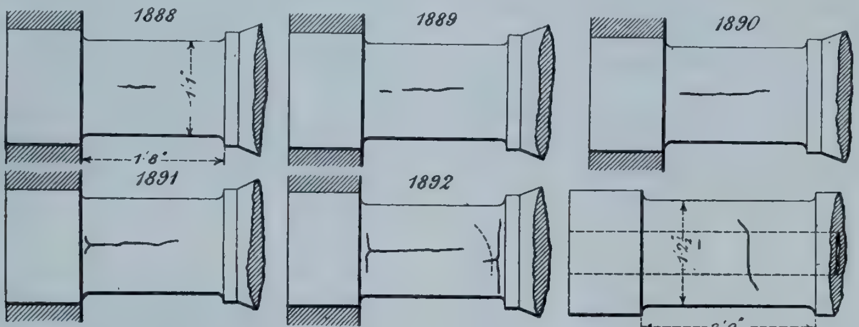


FIG. 26. CAST-IRON SHAFT.

The majority of mill engines have plain shafts with overhung cranks carried in two bearings. In 1879 these shafts, except a few old ones of cast iron and a few new ones of steel, were of wrought iron. Now nearly all are of mild steel. I think most of the breakages may be ascribed to gradual disintegration by wear and tear, vibration of spur-gearing, or to the extension of small flaws or cracks existing in the interior of the shaft when new, or developed upon the surface afterwards by chilling it when hot. The duration of life measured in revolutions of the engine undoubtedly bears some relation to the stress, but it is uncertain what this relation is. I have been able to get fairly reliable information about a certain number of broken shafts, and from it I have plotted the points shown on the two diagrams, Figs. 24 and 25. Fig. 24 refers to wrought iron, and Fig. 25 to mild steel shafts. In both, the abscissae represent stresses calculated by Rankine's formula, and the ordinates length of life in millions of revolutions of the engine. Beyond a general tendency to abbreviation of life by increase of stress, the spots show nothing, but I fear the effects of repetitions of stress are here, and in similar statistics always will be, although obscured by the other causes of breakage I have mentioned, and the difficulty of getting accurate information about shafts which have worked for many years.



FIGS. 28, 29. CRACK AND SCRATCH DEVELOPMENTS IN CRANK SHAFT.

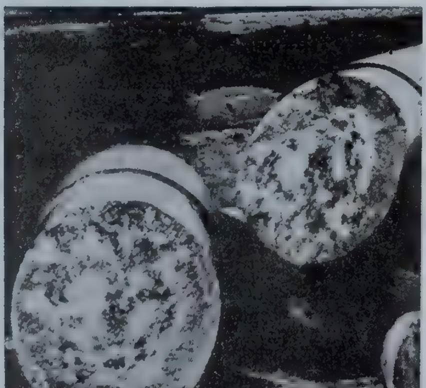


FIG. 27. FACES OF FRACTURE, CAST-IRON SHAFT IN FIG. 26.

I would like to describe a few breakages of crank-shafts. The first case is one of the disintegration of a cast-iron shaft by wear and tear. The dimensions of the shaft are shown in Fig. 26. It belonged to a pair of beam engines, and was put in, with them, in 1850. In 1900 there were several slight longitudinal cracks in both necks, and in the left-hand neck, one 14 in. long, which was said to have been visible for twenty years. On April 7, 1910, this neck got hot, and the mill had to be stopped to allow it to cool. On April 8 it ran hot again, and was examined in the evening, when, besides the 14-in. crack, twenty-four other well-defined cracks of various lengths, up to 5½ in., were visible, all longitudinal in direction and situated near the middle of the bearing. It then transpired that the neck had been hot in 1908, and had been cooled with water. It was therefore doubtful whether the cracks were more than surface cracks caused by the water; but having regard to the age of the shaft, its replacement was advised.

The decision was justified when the shaft was broken under the tup. The fracture surfaces, shown in Fig. 27, did not coincide with any of the longitudinal superficial cracks, but were transverse and diagonal. The new and white fractures were caused by the tup, while the dark old fractures, blackened by oil, were very considerable in extent, and showed the disintegration of the interior of the shaft by age and wear. The right-hand neck showed similar black and white areas when broken. Some particulars of the life of the shafts, so far as they could be ascertained, may be of interest:—

	1850 to 1873.	1873 to *1897.	1897 to 1910.
Millions of revolutions...	70	76	41
Initial load on piston..lb.	90,000	56,500	51,000
Bending stress on neck. in lbs. per sq. in.......	3,650	2,270	2,050
Load on piston at cut-off	76,500	36,800	33.960
Bending stress equivalent to bending and torsion by Rankine's formula.. in lbs. per sq. in.......	3,750	1,930	1,580

*Mill stopped one year during this period.

Total life, 187 million revolutions. Average stress, 2,700 lb. per sq. in.

Fig. 28 shows the gradual destruction of a wrought-iron shaft twenty-eight years old, during the last four years of its life. The first crack, probably the opening of a cinder mark or imperfect weld in the forging, was seen in the left-hand neck in October, 1888. The development during the following three years is shown in the figure. In 1892 it had further extended, and there was also another crack in the right-hand neck, of the development of which I have no record. The cracks shown by the full lines are on the part of the circumference furthest from the crank-pin, those shown by the dotted lines being on the part nearest the crank-pin. The stress in the shaft was 8,500 lb. per sq. in., and the life 123 million revolutions.

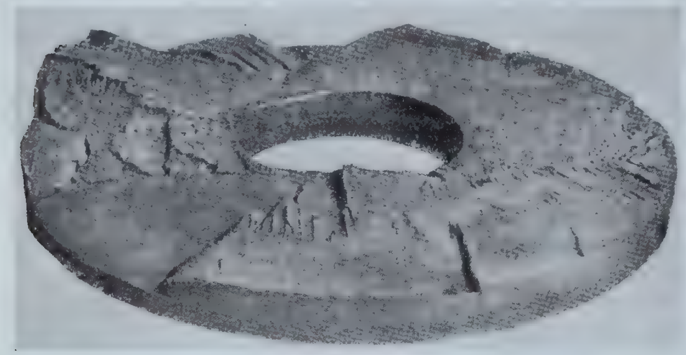


FIG. 30. PIECE CUT FROM NECK OF STEEL SHAFT.

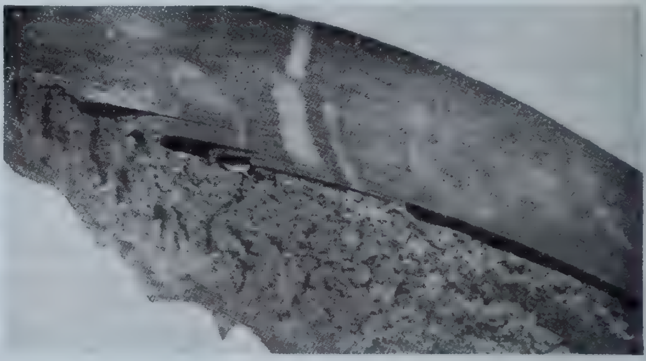


FIG. 31. PIECE BROKEN OFF SHAFT AND MAGNIFIED TO SHOW SMALL SURFACE SCRATCHES EATING INTO THE STEEL.

When speaking of crank-pins, I referred to the effect of scratches or skin cracks upon steel, and I want to illustrate this point. Fig. 29 shows the crankshaft of a pair of McNaughted beam engines running at $32\frac{1}{2}$ revolutions per minute. After the shaft had worked nine years, a very interesting crack appeared in one of the necks, as shown in Fig. 29. For a length of $5\frac{1}{2}$ in. it was absolutely straight, without the jagged edges a crack usually presents, and followed the line of a circumferential scratch, such as might have been made by a knife held against the revolving shaft. At either end it branched off diagonally for a length of $2\frac{1}{2}$ in., each extension having the normal appearance of a crack. I marked it with a center-punch, and let the engine run on. It ran for four months, and then the crack began to extend so rapidly that the shaft was thought to be unsafe, and was replaced. The stress on the neck was about 7,500 lb. per sq. in., and the life of the shaft only $51\frac{1}{2}$ million revolutions.

Fig. 30 shows a piece cut from the neck of a steel shaft, after the shaft had been broken by a tup. The shaft was probably new in 1893. The neck was $13\frac{1}{2}$ in. in diameter, and 26 in. long. Test-pieces cut from the broken shaft gave a tensile strength of 25.7 tons per sq. in., a yield-point of 14.3 tons per sq. in., and elongation of $40\frac{1}{2}$ per cent. in 2 in., and a contraction of area of 60.3 per cent. In 1905 the neck was free from cracks, but in 1908, when the next examination was made, there were a number of fine marks like scratches, principally in a circumferential direction, as clean as if cut with a knife. One in particular about 7 in. from the flywheel end of the neck, was 18 in. long.

As the marks were so fine and clean, it was hoped that they were nothing more than scratches, or, at most, skin cracks brought out by heating, and as the shaft was very lightly stressed, only about 4,500 lb. per sq. in., it was allowed to run on. A few days later, however, the engine had to be stopped, as black oil appeared inside the bore. The long crack was then found to have extended almost continuously around the neck, following one or other of the circumferential scratches. Fig. 31 shows a piece broken off the shaft and magnified about four times, which clearly shows how the small surface scratches were eating into the steel. The cause of the scratches could not be ascertained.

I have only touched briefly on the principal breakages of most of the important parts of a steam-engine, and have excluded reference to the beams, gudgeons, and parallel motions and other parts peculiar to beam-engines, as these are becoming obsolete. I will, however, conclude with an anecdote relating to a beam-engine.

Beams, ''walking beams,'' as they are sometimes called, are usually broken by water in the cylinder or some other extraneous cause, but sometimes they fail gradually from old age, the signs of failure being the appearance of small cracks sometimes in the flanges and sometimes in the webs. A beam in North-East Lancashire began to develop such cracks. They were pointed out to the owner of the engine, their import was explained to him, and he was advised to replace the beam. After listening attentively and in silence to the explanation, he got up, put on his hat, and said: ''Mister, them cracks be nowt! I shan't put in no new beam. Why't has now to do but wag up and doon.''

POWER TRANSMISSION BY ROPES.

AN exhaustive paper on ''The Transmission of Power by Ropes,'' was recently contributed to the ''Proceedings'' of the Textile Institute by Edwin Kenyon. After alluding to the conflicting experiments which have been carried out in Germany and the United States on rope transmission, the author said that with a well-designed installation in which good cotton ropes are used the index of centrifugal detraction might be safely removed a considerable distance beyond the 4,500 ft. velocity determined by the American tests. While it might not be advisable to push the proposition of constant power transmission by ropes to the utmost limit of mechanical endurance, which might mean a rim speed of 20,000 ft. or 30,000 ft. per minute for a properly made steel pulley, all the evidence obtainable from actual experience went to prove that we might safely reckon upon a continued accession of power in the ratio of speeds up to at least 7,000 feet per minute.

Mr. Kenyon then went on to describe actual systems of transmission in proof of his assertion. In support of his case he mentioned the fly-rope pulleys at three cotton mills, one in Lancashire, one in Scotland, and another in Spain. They are all 28 ft. in diameter, making 80 revolutions per minute, or a peripheral speed of 7,037 feet. At the first mentioned mill, two ropes, $1\frac{5}{8}$ in. diameter, drive each of the five spinning-rooms, while the entire load of the card-room, representing 286 horse-power is taken by three ropes averaging 95 horse-power each. The record power, however, appears to have been reached at another mill in the same neighborhood, where two $1\frac{3}{4}$ in. ropes are credited with transmitting no less than 450 horse-power at 7,200 ft., from a driving pulley 13 ft. on to a driven pulley 5 ft. 6 in. diameter.

The author next proceeded to criticize the American system of continuous rope driving, which entails the use of jockey pulleys, mounted upon a weighted carriage. designed for the purpose of maintaining an equality of tension which is never realized. A serious defect of this system of driving is that of having to depend upon one rope, the splicing of which has a habit of giving way, involving long stoppages during the process of replacement; whereas in the English system a damaged rope may be laid aside awaiting a favorable time for repairs, while the rest do the work. When it is added that Manila ropes running in shallow, open grooves of 60 deg. were used in the American experiments referred to, the author states that anything more conducive to loss of efficiency due to unnecessary friction, creep, slip, and lack of impact would be difficult to conceive.

A series of different adaptations of rope transmission were then described, and the author proceeded to consider the formation of rope pulley grooves. He said that for all-round good service there was nothing to beat the flangeless groove with the driving angle carried through to the terminals. The angle recommended is 40 degs., except in the cases of thin bands, such as are used on cotton mules.

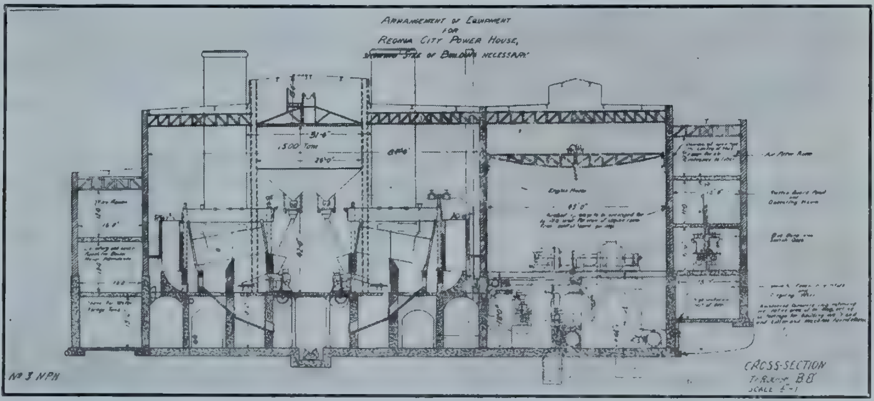
* * *

REGINA MUNICIPAL POWER HOUSE.

THE City of Regina has recently undertaken the erection of a new power and light plant, the existing installation having for some time been inadequate to meet increasing demands. The estimated outlay, $425,000, will provide for an addition of 6,000 k.v.a. to the capacity of the present plant, also a complete equipment of the latest labor and power-saving devices, including water tube boilers, mechanical stokers, coal and ash handling machinery, etc.

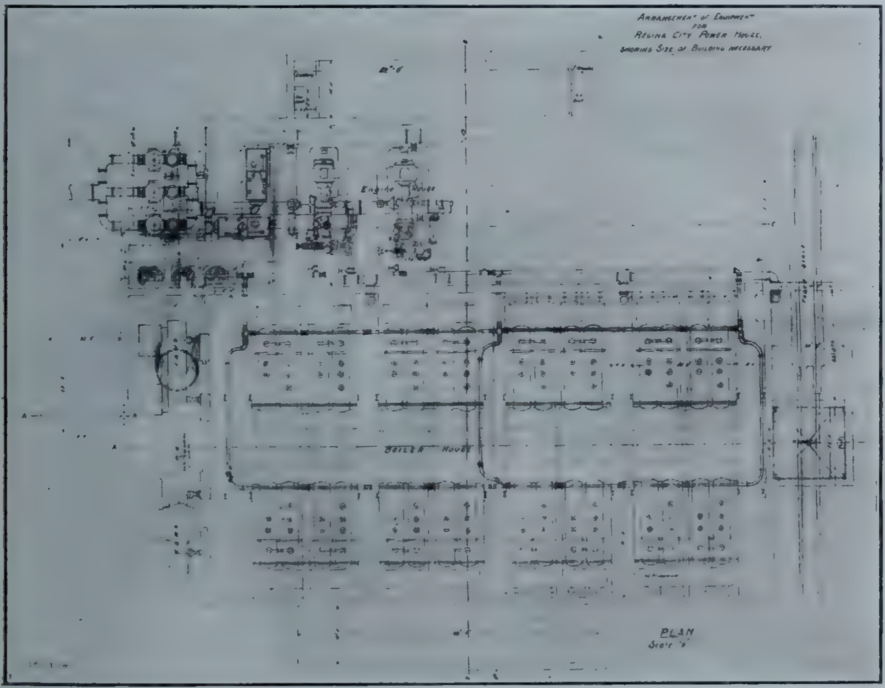
The new power house now under construction is of fireproof steel, brick, and stone construction, and is 218 by 170 feet. It is situated on the shore of Wascana Lake, where an abundance of water is available for the condensers and other purposes. The present supply is drawn from the city mains. All interior finish will be of tile, and provision has been made for a visitors' gallery, as well as thoroughly modern residence quarters for the chief engineer.

EXTERIOR OF POWER HOUSE.



Arrangement of Equipment for Regina City Power House, Showing Size of Building Necessary
Engine House
No 3 NPH
Cross-Section Through BB

CROSS SECTION THROUGH POWER HOUSE.



Arrangement of Equipment for Regina City Power House, Showing Size of Building Necessary
Engine House
Boiler House
Plan

PLAN OF POWER HOUSE, SHOWING EQUIPMENT LAYOUT.

The power equipment will consist of sixteen boilers of 8,000 aggregate horsepower, two 1,500-k.w. steam turbo-generators, and one similar unit of 3,000 k.w., in addition to the present plant. The whole will be served by an electric traveling crane of ample capacity.

Coal bunker storage will be provided for 1,500 tons, the cars being brought to the plant over the city lines. All handling machinery will be automatic, and will include, besides a track scale, a device for weighing the coal as it goes to the stoker hoppers.

All boiler and engine units will be so arranged that one or more may be independently shut down, and a complete set of instruments will show the condition of every unit in the chief engineer's office. It is expected that, aside from the elimination of smoke and other advantages accruing from this modern installation, that the price of power and light will be materially reduced to the consumer.

Safety Provisions Relative to Transmission Machinery—II.

By W. Sydney Smith.

An official report by the Inspector for Dangerous Trades in England, regarding fencing and safety precautions for transmission machinery, has been issued. It explains the structural and administrative safeguards with regard to the several parts of transmission machinery which experience shows to be needed for the protection of persons employed.

OVERHEAD pulleys within reach of the workers should be fenced underneath, Fig. 11, with strong guards of metal or wood, which should be extended to protect the low-lying portions of horizontal and oblique driving bands in order to prevent accidental contact with moving parts, and especially at the intake between belt and pulley, which is the most dangerous part. Accidents are often due to contact with the spokes of pulleys and wheels in motion. Hence the sides of spoked pulleys within reach of workers, or to which they may have access, should either be fenced or the spokes filled in with circular disks to convert them into plate wheels. The sides of all drums in the grinding rooms of tenement factories are required to be closely fenced, and the need is the same wherever spoked pulleys are accessible to the workers.

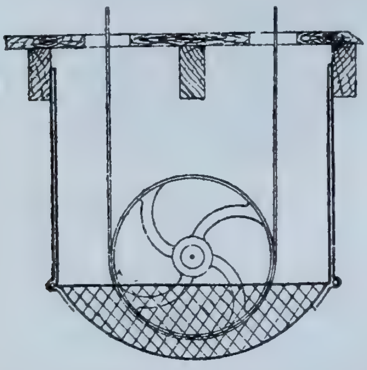


FIG. 11. HINGED WIRE NETTING GUARD FOR OVERHEAD BELT AND PULLEY.

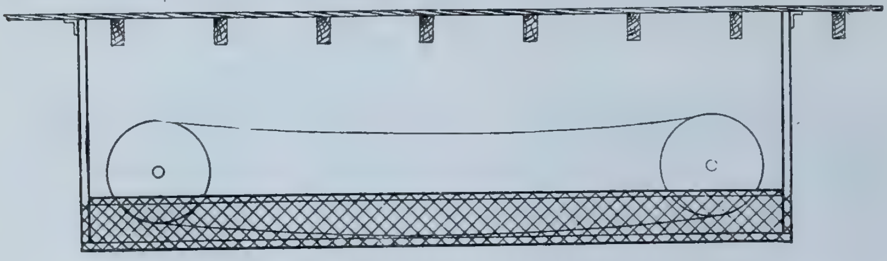


FIG. 12. EXPANDED METAL GUARD FOR OVERHEAD BELT.

Belts, Ropes and Chains.

As regards the fencing of belts, the conditions are materially different from those of shafts and pulleys. Heavy overhead belts which may never be approached whilst in motion, and are to that extent safe by position, often require to be protected underneath as a safeguard in case of breakage; further, the fencing of the low belts driving the individual machines, e.g., looms, lathes, and other machine tools, is in many cases impracticable, and though such belts are strictly mill gearing, little danger arises where metal fastenings are avoided and efficient strap forks are provided.

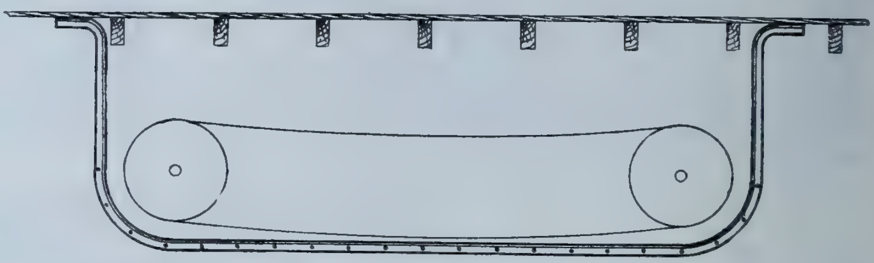


FIG. 13. LADDER TYPE GUARD FOR OVERHEAD BELT.

Periodical examination of belts would lessen the number of breakages. Belt accidents would also be reduced by prohibiting the use of projecting metal fasteners, or by requiring all belts with such fastenings to be fenced. There is, however, always risk of accident arising from contact at the intake between belt and pulley or contact with running belts, and fencing is necessary in the following circumstances:—

(1)—All vertical and oblique belts (irrespective of size and speed) passing through floors should be fenced around the openings to a height of at least 4 ft. Where the belts are oblique, it may also be necessary to fence the underside of the belt to a height of at least 6½ ft., so as to prevent accidental contact.

(2)—Horizontal and oblique belts used for main driving and counter-driving within 6½ ft. of the floor or other place to which the workers have access while the transmission machinery is in motion, should be securely fenced by rails or casings so as to prevent accidental contact.

(3)—All overhead main driving belts, if more than 4 in. wide and moving with a velocity of more than 30 ft. per second, should be protected underneath with strong guards of wood or metal at those parts where persons are liable to pass under them.

The protection under heavy overhead belts must be substantial, e.g., troughs of wood, sheet metal, perforated or expanded metal, strongly constructed and firmly supported by the walls or beams, (Fig. 12). Ladder-like guards made of angle irons fitted with metal rungs (Fig. 13) or strong bow-shaped iron cleats fixed at intervals (Fig. 14) are also efficient; the latter types will not interfere with the examination of the belt or of a rope and have the advantage that the driving bands or ropes are always visible.

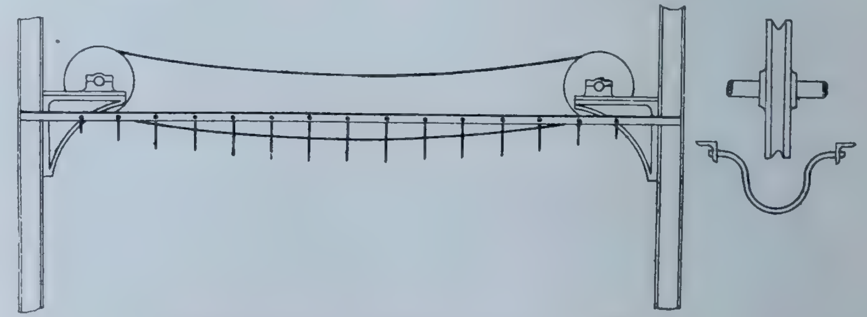


FIG. 14. BOW-SHAPED IRON CLEAT GUARD FOR OVERHEAD ROPE.

Fencing of other driving-belts, in addition to main-driving and counter-driving belts may be necessary according to position, size, speed or special circumstances, but much judgment and experience are necessary. Low belts near the floor level and high-speed belts should in general be guarded, but each individual case must be considered on its merits as to the degree of danger and the nature of the fencing requisite under the circumstances. Many belt fasteners are dangerous on account of metal projections, but of metal fasteners those consisting of a continuous wire stitching held together by a peg other than a metal peg, are safe.

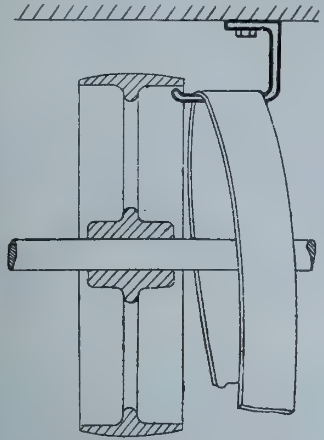


FIG. 15. SIMPLE BELT PERCH.

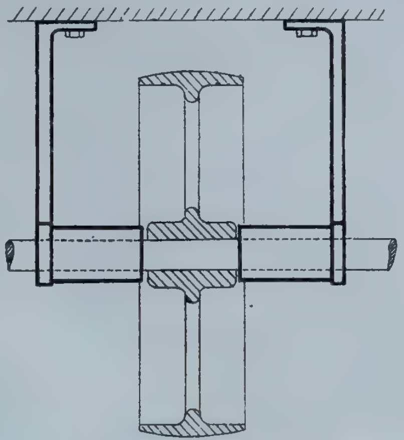


FIG. 16. SLEEVE BELT PERCH.

The fencing of driving ropes, except overhead ropes, should generally be on the same lines as the fencing of belts. There is not the same need for fencing small overhead driving ropes, as ropes never break without showing signs of wear and giving ample warning before breakage by the production of quantities of fluff, unlike belts which generally break unexpectedly.

Driving chains of metal, on account of their weight, are more dangerous than belts or ropes; the intake between a driving chain and pulley being as dangerous as the intake of toothed gearing. Chain belts should at least have a strong trough underneath, whatever their position, and if accessible they should be enclosed.

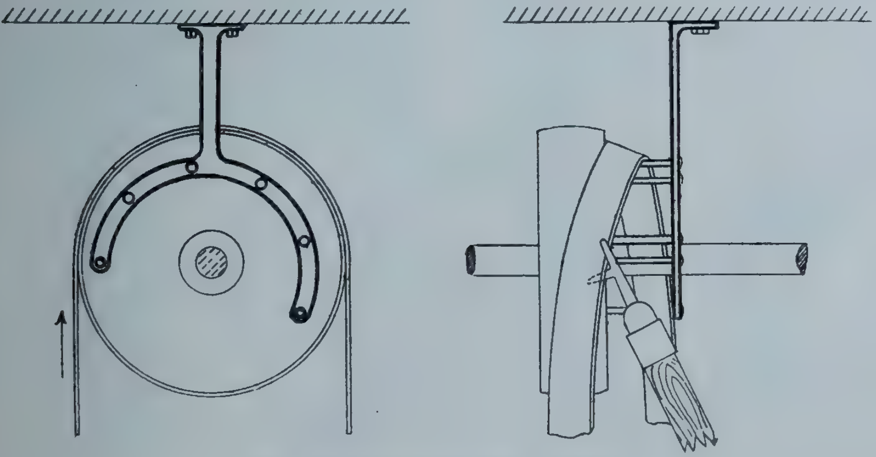


FIG. 18. IMPROVED BELT PERCH.

Belt-Perches.

Belt-perches are closely associated with the fencing of belts. Where machines are worked intermittently, it is a common practice in many factories, after the use of a machine, to throw the driving belt off the shaft pulley until the machine is again required, in order to economize power and to save wear and tear of the belt and pulleys. A belt may also slip off the driving pulley accidentally, or may be thrown off intentionally for the purpose of repairs. It is a dangerous practice, however, to allow a belt under such circumstances to rest on a revolving shaft, owing to the liability of the shaft to seize the belt and wind it up. Accidents, due to falls of shafting and parts of the machinery, have often occurred from such a cause. Many fatalities and serious accidents have also happened to persons on taking hold of a belt resting loosely on a revolving shaft, they having been suddenly carried up to the shafting owing to increase of frictional resistance between the belt and the shaft.

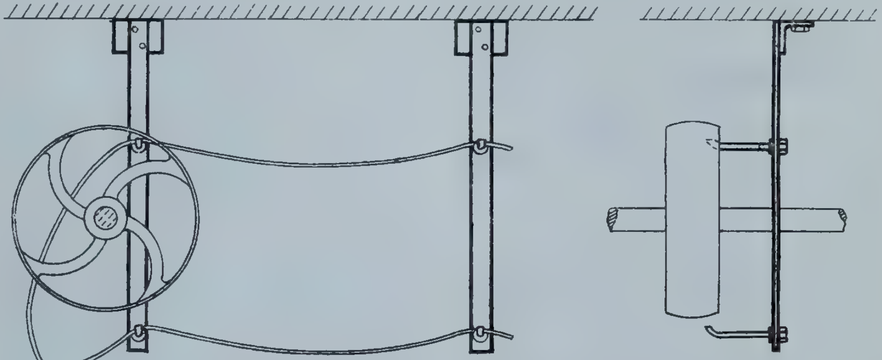


FIG. 17. BELT PERCH FOR HORIZONTAL BELTS.

Provision must be made in all cases to keep loose belts out of contact with revolving shafts. There is no danger if the shaft is fenced by a sleeve of metal or other material. In other cases some type of belt-hook or belt-perch must be used, and various forms are available. The simplest (Fig. 15) consists of a strong hook fixed adjacent to the driving pulley, with the horizontal portion somewhat longer than the width of the belt and the end turned up under the pulley rim. Another type, consisting of a sheet-iron sleeve or trough riveted to a bracket, is shown in Fig. 16.

A belt-perch may be fixed on each side of a pulley if it be desired to displace the belt on either side. For horizontal belts, the perch may consist of a simple bracket provided with two pegs as in Fig. 17, fixed near the driving pulley and shaft; while similar brackets may be fixed at intervals to support a long stretch of horizontal displaced belting.

A better type, where belt-poles are used to replace belts, is shown in Fig. 18. This consists of four or more parallel pegs with turned-up ends, bolted to a curved bracket fixed eccentrically near the pulley.

* * *

Escher, Wyss & Co., Montreal, have been awarded a contract by the town of Joliette, Que., for the supply of one 200-h.p. Francis turbine and two belt-driven centrifugal pumps, each of two million gallons capacity, working against 62 pounds pressure when single and in parallel, and 130 pounds pressure when working in series. Surveyer & Frigon, of Montreal, are the consulting engineers.

Results of Neglected Leakage from Boiler Joints, Etc --III.

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

WITH the exception of the illustration, Fig. 22, and its accompanying text, the present article, No. 3 of the series, features leakages arising from cracks whose origin has been that of unequal expansion of the boiler structure.

Fig. 22 shows a piece of one of the of about 1 m.m. A leakage with(ooyd-f drums of an elephant boiler, with two drums fired by blast furnace gases. The plates show general wear and tear to an extent of about 1 m.m. A leakage has caused along the caulking a groove of corrosion of 150 m.m. long and 10 to 12 m.m. wide. Its depth in places is 6 m.m. Along the length above mentioned the plate is corroded almost into the line of rivets. The head of these is equally badly corroded.

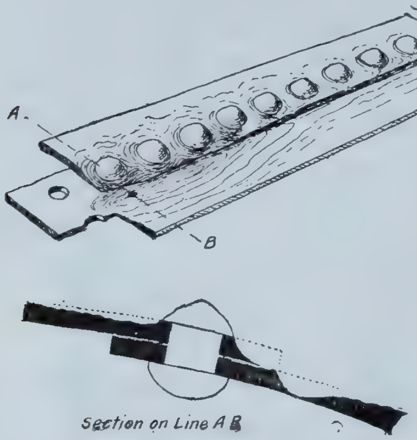


FIG. 22.

Expansion Crack Leakages.

Fig. 23 refers to a crack extending over a length of about 600 m.m. on the side of a circular seam of one of the drums of a Parker boiler, the fires of which were very much forced. The crack commenced at the longitudinal seam, and little by little had extended towards the bottom. It occurred on the inner side of the plate.

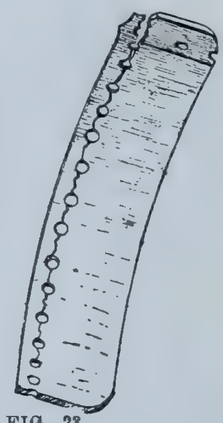


FIG. 23.

Fig. 24 shows a crack in a circular seam of the reservoir of a multitubular boiler. The crack showed itself when the fires were lit prior to getting the boiler under steam. It extends over a length of 3m. 89, and shows evidence of leakage for about 800 m.m. The boiler, the fires of which were very much forced, had been emptied a very short time before stopping work. The crack occurred on the outer side of the plate.

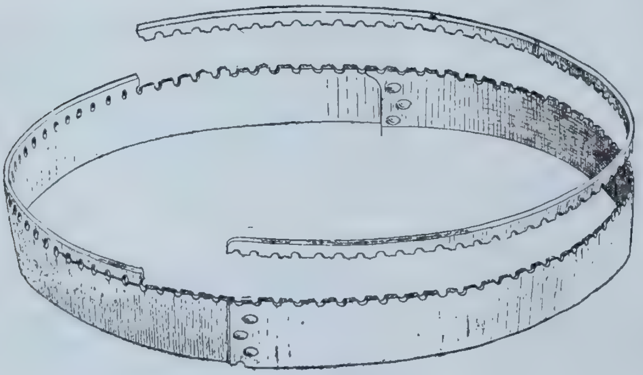


FIG. 24.

A crack at the ninth circular seam of a long boiler with feed heater is indicated by Fig 25. It occurred on the inner side of the plate. The excessive traces of re-caulking to be observed at the edge show that this seam had repeatedly leaked. The boiler was covered with brickwork which was much too thick and prevented its free movement, hence the leaks and the cracks.

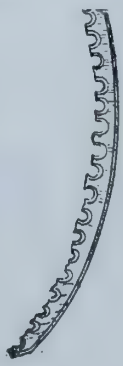


FIG. 25.

Fig. 26 refers also to a Parker boiler, the fires of which were at times severely forced, and shows a crack at the second circular seam of one of the lower drums. The crack occurred on the inner side of the plate. It embraced the whole of the lower semi-circumference, and from the appearance of the fracture had commenced at the bottom. The furnace plates of this boiler were warped through the excessive heat of the fires. Further, the firing up and laying off of the boiler were carried out much too quickly.

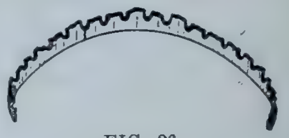


FIG. 26.

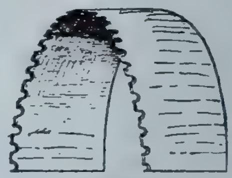


FIG. 27.

Fig. 27 indicates a crack in the circular seam of a drum, although it does not present any trace of leakage. It has occurred on the inner side of the plate.

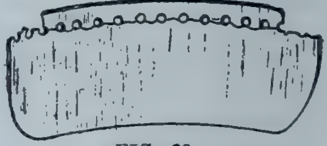


FIG. 28.

Fig. 28 shows a crack also in a circular seam of a drum. The crack occurred on the inner side of the plate and is of long standing. Near the caulking, a groove of corrosion shows that this seam has for a long time given rise to leakages. The seam had been re-caulked a certain number of times. The plate shows a series of grooves, due to the re-caulking.

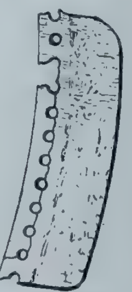


FIG. 29.

FIG. 30.

A crack at the third circular seam of

the main shell of an elephant boiler in a sugar refinery, the fires of which were severely forced and too quickly started up and let down is shown in Fig. 29. The feed water was delivered into the bottom of the shell. The crack has occurred on the outer side of the plate, and has been preceded by a leakage which must not have been going on long, for there was no corrosion. The main shell of the boiler is fired unequally; the bottom first coming in contact with the gases.

FIG. 31.

Fig. 30 refers to a crack at the second circular seam of a semi-tubular boiler. The seam is just above the furnace bridge, i.e., at the place where the heat is most intense. The feed water is delivered into the bottom of the shell. The crack is on the inner side of the plate. Before giving way, the seam gave rise to leakages. The edge of the plate is much thickened by the repeated re-caulkings.

A crack in a circular seam of the main shell of a boiler with feed heater is shown in Fig. 31. The crack has occurred on the outer side of the plate.

FIG. 32.

Fig. 32 is from a boiler with two drums, the crack extending 1 meter in length in the fourth circular seam of one of the drums. This boiler was working in a sugar refinery, and the fires were severely forced. The boiler stopped one night for slight repairs, and had been emptied seven hours after the stoppage. Very shortly after, a commencement was made to fill the boiler with water prior to setting it again to work, and the crack was noticed as soon as the fires were re-lit. The crack occurred on the outer side of the plate.

FIG. 34.

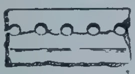


FIG. 35.

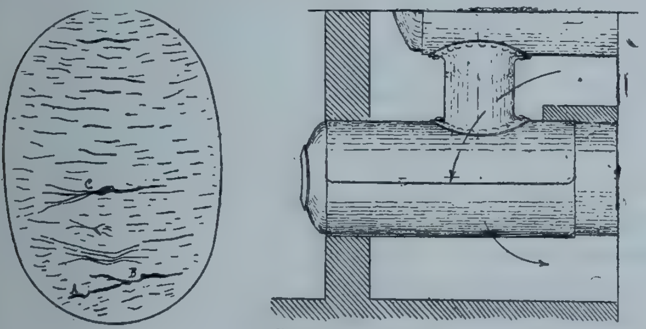


FIG. 38.

FIG. 39.

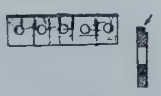


FIG. 41.

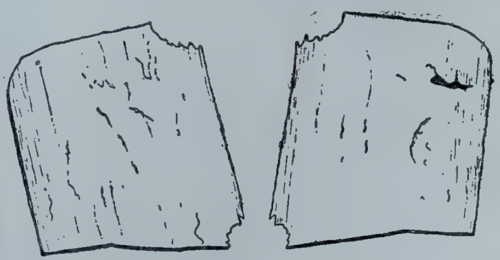


FIG. 40.

Fig. 33 refers to a boiler with feed heater, having a crack in a circular seam of the feed heater at the lower part. There is one crack on the inner side of the plate and another on the outer side. The outer caulking has given way considerably, but there does not appear to have been persistent leakage. The practice has been to empty the boilers very shortly after ceasing work.

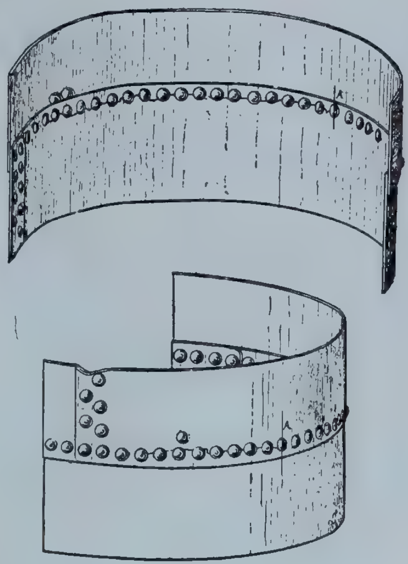


FIG. 33.

Fig 34 refers also to a boiler with feed heater, and in which there was a crack at a circular seam of the feed heater at the upper part. The crack occurred on the outer side of the plate. There was also exterior corrosion of 3 to 4 m.m., while the rivets are practically headless.

Fig. 35 shows a crack at a circular seam of the main shell of a boiler with feed heater. The crack is on the inner side of the plate.

FIG. 36.

FIG. 37.

A crack at the second circular seam of an elephant boiler is shown in Fig. 36. The boiler has been emptied immediately after the extinction of the fires, then filled with cold water.

Fig. 37 shows a piece of a tube of the lower row of a multitubular boiler. The tube is constantly reformed and bends under the more or less intense heat of the fire. These repeated deflections have finally produced close to the junction with the shell a circular crack. The metal of the tube is brittle.

Fig. 38 is a piece taken from the upper part of the last shell ring of a lower feed heater at the part where the flames come in contact with it after leaving the boiler shell. The boiler fires were severely forced. The plate was practically covered on both sides with cracks, sometimes rather deep, and running for the most part transversely.

Fig. 39 is a similar case to the preceding. The piece of plate presents two cracks measuring respectively 90 and 45 m.m. in length. Further, under the effect of the pressure, the plate has been slightly bulged towards the outside.

Fig. 40 refers to a piece of the furnace plate of a boiler with feed heaters. Owing to overheating, a series of small longitudinal cracks which appear rather deep are to be found on the inner side. On the outer side also, some rather deep cracks were noticed. At one point the plate is divided into two parts; the outer, which is subjected to excessive heat, being fractured.

Fig. 41 is a piece of plate from a feed heater. The inner side of the plate shows a deep crack along the caulking but starting from the outside. The outer side of the plate shows that the caulking was excessive. The brickwork setting of the boiler was in a bad state.

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Steam Raising Development.—A demonstration of the possibility of steam raising by the combustion of liquid fuel directly in contact with water has been made in Bremen, Germany. An apparatus consisting of a cylindrical boiler, provided with a number of pockets isolated and drained by suitable valves and drain cocks, was used. Each of these pockets contains an oil burner, with a pilot burner, by means of which the main burner can at starting be sufficiently heated to effect complete combustion of the oil. When the main burners are well alight, water from the boiler is permitted to flow into the previously drained pockets, and the circulation of heated water commences.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

DESIGN AND CONSTRUCTION OF HYDRAULIC TURBINES.*

By H. B. Taylor, M.Am.S.M.E.**

PREVIOUSLY published sections of this paper dealt with questions of efficiency, the draft tube and runner feature, reliability, corrosion and type capacity. In the present instance, multi-runner type disadvantages, single runner unit advantages and installation data are treated.

Multi-Runner Type Disadvantages.

Now consider the disadvantages of the multi-runner type of turbine.

1. Two or more sets of gate mechanisms are required.

2. Equal gate openings on all runners are difficult to obtain at all degrees of openings, owing to the lost motion or torsional deflection in the gate operating shafts.

3. One of all of the gate mechanisms are completely submerged and are not accessible until the unit is shut down and the wheel-casing is drained, therefore, the breakage of a gate connection may only be detected by the falling-off of the power output from the generator. In addition to this, a number of the main shaft bearings are inaccessible.

4. When multi-runner, horizontal shaft type units are installed, it is frequently necessary to have the generator floor below high tailwater level.

5. It is often impossible to place the runners sufficiently far below the headwater surface to avoid the formation of vortices and the drawing of air into the turbines. This condition frequently impairs speed regulation as well as efficiency, and invites corrosion. When multiple runner horizontal units are set in enclosed casings, this trouble may be avoided; but another disadvantage then appears, since there is a loss of head as the water passes each wheel and draft chest, and the runners last in line have in some cases been found to be operating under a considerably reduced head.

6. In the case of a vertical turbine having more than one runner, the depth and, consequently, the cost of substructure of the power house is necessarily much greater than in the case of a vertical shaft single runner turbine.

7. The cost of erection and of dismantling for repairs in the case of multi-runner units of either the vertical or horizontal type is considerably more than in the case of the vertical shaft, single runner type.

8. The opportunity for lost motion in the connections between the governor mechanism and the wicket gates is, of coarse greater, the larger the number of runners used with the corresponding gate mechanisms, consequently, in the case of multiple-runner wheels, there is a proportionally greater opportunity for hunting to develop in the operation of the governors than in the case of single runner turbines.

9. In any type of turbine having two or more runners in which the runners discharge against each other into a common draft chest or chests, there is considerable loss in efficiency due to interference of discharge as already explained, unless the distance between runners and, therefore, the length of the turbine and the cost thereof, is greatly increased. The higher the specific speed, the higher is the discharge velocity from the runner buckets and, as the loss in the draft chest or tube is proportional to the square of the velocity, the loss in efficiency increases with the specific speed. It necessarily follows that in the case of high specific speed wheels, great care must be exercised in properly designing the draft chests and draft tubes. The avoidance of sharp bends in the immediate neighborhood of the runner discharge is an advantage obtainable with the single runner vertical turbine.

Single Runner Unit Advantages.

Among the principal advantages of the single runner unit are the following:

1. Only one gate mechanism is required, and this is located above the head cover of the turbine and is accessible at all times for inspection while the unit is in operation. The only parts of the turbine that are submerged are the runner and guide vanes. Repairs can be made to the gate operating mechanism without dismantling the turbine.

2. Owing to the fact that only one gate operating mechanism is used, involving a small number of parts, the chance for breakage is reduced to a minimum, and lost motion and deflection in the governor engine connections are avoided.

3. It is possible to secure in a single runner unit an ideal draft tube of long tapering section, without an obstruction or sudden turn; therefore, with this type of wheel it is possible to use runners of the very highest specific speed, as the draft tube can be designed to convert the velocity at the discharge from the runner buckets into effective head with small degree of loss.

4. With a single runner vertical unit, it is possible to mold in the concrete a spiral turbine casing similar in design to the cast iron spiral casings used in connection with high head turbines. It would be impracticable to prepare spiral casings for vertical or horizontal turbines having two or more runners, for obvious reasons. In a single runner turbine operating in a spiral casing, the water is directed to the runner at uniform velocity around its entire circumference, producing more uniform operation and higher efficiency thereby. In the case of the multi-runner vertical or horizontal wheels, however, it is necessary to set these wheels in open flumes or cylindrical casings, in which case the water is not guided uniformly to the runner, consequently, the approaching water is in a more or less turbulent state from eddies and whirls. In order to eliminate excessive loss in efficiency due to these eddies and whirls, it is essential to keep the velocities extremely low in the flume by increasing the dimensions of the flume, and therefore the distance between wheel-centres.

5. It is very often possible with turbines of the single runner vertical shaft type, to locate the runner and gate mechanism above high tail water level, so that after the closing down of the head gates and drainage of the wheelpit, an attendant may examine all parts of

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*Part III. of paper read before the Mechanical Section of the Canadian Society of Civil Engineers, Montreal, on Jan. 15, 1914.

**Hydraulic Engineer, the I. P. Morris Co., Philadelphia the turbine without first having to pump out the wheel-chamber.

The theory of the flow of water through runners as derived from low specific speed wheels is not applicable, without modification, to the design of high specific speed runners, on account of a number of new factors which must be considered. Low speed wheels are such as are usually applied to high head turbines. The runners installed in the various units at Niagara Falls are examples of low and moderate speed types. Exact data regarding the performance of projected turbines of large size, when the specific speed is high, can be most easily and accurately obtained through tests on a model at the Holyoke flume.

Turbine Installation Data.

It may be of interest to note that the experimental runner tested at Holyoke for the two 17,000 horse-power turbines recently installed in the plant of the Pennsylvania Water & Power Co., at McCall Ferry, Pa., gave an efficiency of 90.62%. The actual efficiency of the large units, as approximated from the power output, is in the neighborhood of 87.5%, showing a loss of approximately 3%. The McCall Ferry turbines are of the vertical shaft, two-runner type, each runner discharging downward into an independent draft tube, which is the best possible arrangement for a turbine of this type. It was necessary, however, in the case of the draft tube below the lower runner to make an extremely sharp turn so as to avoid excessive excavation, and both draft tubes were so modified on account of structural conditions that the distribution of areas is hydraulically defective. The turbines are installed in open flumes of rectangular dimensions. The difference in efficiency, therefore, between the model runner and the large turbines may be easily attributed to loss due to unfavorable hydraulic conditions in both draft tubes, and particularly to the sudden turn in the lower tube, and also to the usual losses which occur in an open flume setting.

In the case of the Appalachian turbines, which are of the vertical, single runner type, having concrete spiral cases and ideal draft tubes, very exhaustive efficiency tests were made on two of the wheels, measuring the water by means of a carefully constructed weir 82 feet across the crest. The average efficiency secured in the two wheels tested was found to be 93.7%. The model runner showed at Holyoke a maximum efficiency of 89.68%, consequently, the large units in place showed 4.02% in excess of the maximum efficiency secured in the model runner. This comparison clearly indicates that the vertical single runner turbine with a spiral casing is more efficient than the experimental wheel, while the efficiency of the vertical two-runner turbine operating in an open flume is considerably below the efficiency of the experimental setting; and, therefore, the difference in efficiency between the vertical single runner turbine and the two-runner vertical turbine is a very appreciable amount.

There have been quite a number of horizontal two-runner units, having central discharge chests, which have been carefully tested in place. These units seldom show efficiencies above the experimental models. The only cases in which large turbines of this type have exceeded the efficiency of the experimental model have been in units of very high power having carefully designed draft chests, or in instances where the specific speed was not high; or where the experimental models used in the comparisons were tested in inefficient settings.

The advantages enumerated in favor of the single runner vertical wheel have made that type of turbine most desirable for low head installations and also for many high high head developments, and undoubtedly this type of unit will be very generally adopted in the future.

◆

OFFICERS ELECTED BY ELECTRICIANS.

THE Canadian Electrical Association concluded its twenty-fourth annual meetcluded its twenty-fourth annual meeting on June 26. Colonel D. R. Street, Ottawa, was re-elected president, and the other offices were filled as follows.—First vice-president, D. H. McDougall, Toronto; second vice-president, R. M. Wilson, Montreal; third vice-president, Wills Maclachlan, Toronto; honorary secretary, T. S. Young; secretary-treasurer, Alan Sullivan, Toronto. Managing Committee—J. S. Gould, Smith's Falls; G. W. Magalhaos, Toronto; P. T. Davies, Montreal; H. G. Matthews, Quebec; A. E. Dunlop, Pembroke; J. S. Norris, Montreal; Geo. Kidd. Vancouver; Robin Boyle, Niagara Falls; W. G. Angus, Hamilton; W. S. Robertson, Toronto; E. L. Milliken, Sydney; L. W. Pratt, Hamilton; H. R. Mallison, Montreal; H. Hulme, Montreal. The next place of meeting was left to the managing committee to decide.

◆

ELECTRIC POWER FROM ANTHRACITE CULM

A REMARKABLE plant for generating electricity from unmarketable anthracite culm has been recently installed at Hauto, Pa., by the Lehigh Navigation and Electric Co. Two factors have previously hindered the utilization of this low-grade coal; its cost of transportation being the same as that for the higher grade of anthracite, and the large quantity of coal dust in the refuse renders a special furnace necessary for its proper combustion. The transportation difficulty can be overcome by turning the energy of the coal into electricity and transmitting the power by wire. The type of furnace to be used has received great attention from the designers of the Lehigh Company plant.

Grates for both hand and mechanical firing have been installed, and their respective performances will be watched with interest. The combustion chambers are large and the air supply has been so arranged as to ensure a thorough burning of the fuel. The other features of the equipment, both for generating and transmitting the power, are modern and of a high standard. Evidently the men who are behind the project are confident that the proximity of a good market—Philadelphia and New York being within the radius of economical transmission —justifies the building of an expensive and up-to-date station, even though the fuel to be used is of a kind which is ordinarily wasted.

At Bankhead, Alberta, coal of a similar quality occurs. Huge dumps of this unmarketable material are to be seen near the mines, but the market for electricity in the vicinity is, unfortunately, limited. However, a certain amount of this culm is being used for making briquettes, although there is more of it than can at present be profitably utilized even in this way.

◆

Replacing Belts on Pulleys.—A number of appliances, both portable and fixed, have been designed for replacing belts on pulleys from the floor level. For belts not exceeding 3 in. wide, states the writer of an article in Vulcan, an ordinary belt pole may be used. This is a strong, light pole about 1½ in. diameter, carrying at its upper end a wrought iron pin at right angles to the axis of the pole. The length of the pole should not be less than the height of the shafting above the floor level. There is risk of accident with a short pole, as the lower end is liable to be driven forcibly towards the workman. A rigid belt pole is unsuitable in many cases, and its use may be considerably limited by position, size, length, tension, or direction of the belts, or by such obstructions as pillars, beams, and walls. Various types of jointed and flexible belt poles have been devised to overcome these difficulties; a flexible pole is probably safer to handle than one of the rigid type. When the belts are too heavy or the shafting too high to allow the use of a belt pole, mechanical belt shippers enable the belt to be replaced on the driving pulleys from the floor level with perfect safety, without stopping or slowing the transmission machinery.

REFRIGERATION DEPARTMENT

DISTILLED WATER EVAPORATOR PLANTS.*

By R. D. Kehoe, Chicago.

WE hear and read much these days of new ice plants making 9, 10 and 11 tons of ice per ton of coal burned, if such economy be possible. Let me respectfully suggest to ice machine manufacturers that they show their customers what changes to make in their plants to achieve similar results. There are any number of plants installed within the last five years that can possibly, by installation of additional equipment, be brought up to the same high degree of efficiency.

First, I will take the compression type of plant, say, from 50 to 100 tons capacity with simple Corliss engine driving compressor, electric driven air compressor for hoist, river or well pump, stoker engine, boiler feed pump and other auxiliary units. We will say that the compression engine is using 28 pounds of steam per h.p. hour and the auxiliary units anywhere from 50 to 200 pounds of steam per h.p. hour.

Everybody knows that it was previously the policy of ice machine manufacturers to pay no attention to economy of operation in the auxiliary units, their argument being that you required the steam anyway for ice making, and they might just as well give it to you that way as to make it necessary to bleed your boilers. The result is that the average distilled water compression plant is not making any more than from four to six tons of ice per ton of coal burned. Of course, I know that there are other details that have to do with cost of operation, such as care of boilers, proper firing, etc., but these are points you are already familiar with, and I will not dwell on them.

Pump Exhausts for Ice Making.

It is a fact that it is no longer necessary to use any of the exhaust of pumps, etc., for ice making. Any ice plant can be operated with less exhaust steam than what is supplied by the main compressor engine, and, by the way, the means of doing this absolutely guarantees you against possibility of having either odor, taste or color in the butt or core of the ice, because none of the exhaust steam is used for ice making. I mean by this that only the heat in the exhaust of main engine is used to produce an absolutely pure water, and the resulting condensation after filtration is put back into the boilers at boiling point. This makes it possible to install more economical auxiliary units. They can be operated by electric motor, and if you cannot purchase current cheap enough in your locality you can install a compound high-speed engine generating unit large enough to take care of all auxiliaries and lighting. This change has brought some plants up to an efficiency of seven and eight to one and improved the product to such an extent that the ice is more readily marketable.

In the case of the absorption type plant, any manufacturer of absorption machinery will install an exhaust steam generator, multiple effect evaporator and some additional equipment that will bring the efficiency of the plant very nearly up to the point that would be obtained by a complete new equipment.

Now, in regard to the operation of compressors and auxiliary units with electric motors or oil or gas engines, I desire to point out to you that you can produce a better product and at a lower cost with a separate boiler and evaporator equipment than you can with any raw water ice system on the market. This seems to be a broad statement to make, but I venture to say I can secure the backing of most of the large ice machine manufacturers in making it. In the first place you should know that with an evaporator you can produce as much as seven pounds of water per pound of steam, and this steam can be produced by burning coal, oil or gas under a small auxiliary boiler. Further, if desired, it need not be necessary to operate this boiler at a pressure higher than 20 pounds gauge pressure.

Cost of Producing Distilled Water.

I have found it quite difficult to secure information on the cost of producing distilled water in such plants. The only accurate data I have is in connection with an electric driven plant in Buffalo. This plant has been in operation over five years, and they are now producing a ton of distilled water at an average net cost of 14 cents. I believe the cost with gas or oil fired boilers would be less than this. On the other hand, the raw water plant requires approximately 70 per cent. more power for tank operation than a distilled water plant.

I recently visited a 150-ton raw water plant in the East and found they were using about 42 h.p. more in the way of blower and pump duty on the tank that would not, of course, be required for a distilled water tank. In addition to this with the system of raw water where the cores have to be syphoned, there is additional loss of refrigeration due to throwing away this core water. In the case of a 110-ton tank I figured that in dollars and cents this loss amounted to $2.70 a day.

Still another expense to be figured in connection with a raw water tank is the necessity of employing a higher grade of and more labor on the tank. In one case I found they had to pay the tankmen $3 a day on eight-hour shifts. In another case they were forced to employ four additional men on the tanks to take care of air, syphoning, etc. Therefore, if you can produce distilled water for 14 cents a ton or less and eliminate these difficulties on the tanks and also produce a purer and better grade of ice, it seems to be that the distilled water evaporator plant is a much better proposition.

◆

Cranbrook, B.C.—The water-works by-law, involving an outlay of $110,000, was carried by a vote of 153 to 11.

W. W. Carruthers, Ltd., Winnipeg, have secured the sole distributing rights for Canada of Daum's plastic metallic packing. This product is manufactured at Portage La Prairie, Man.

Moncton, N.B.—The Council are considering the question of installing a municipal lighting system. The cost is estimated at $15,000, and includes a 450 h.p. gas engine working on natural gas, and direct connected to a 300 k.w. a.c. generator. It is proposed to open negotiations with the Moncton Tramways, Electricity, and Gas Co. with a view to taking over this company's poles, lamps, wires, etc. J. Edington is city engineer.

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*From a paper read before the Southwestern Ice Manufacturers Association.

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PRACTICAL EDUCATION FOR ENGINEERS.

WHILE it is true that technical schools in Canada have not reached the state of perfection attained by those in some foreign countries, few operatives make the best use of the advantages at hand. The school education at best can but teach one to understand that which he reads and observes. The man who expects a university, by some mysterious means, to transform him into an engineer, and the youth who depends upon the technical school to add to him the essentials of a master mechanic have both still to meet their keenest disappointments.

The best and most useful practical education is that which is gained by one's personal experience or which is learned from those nearest to practical work. This education is to-day the cheapest, rarest and most paid for. The price is application and self-sacrifice.

Nearly all reputable builders of machinery publish accurate instructions concerning the operation and sphere of usefulness of their machines which are gladly furnished the interested operative without cost. A great number also publish, at considerable expense, a well-edited and illustrated treatise dealing not only with the methods employed in connection with their particular product, but give a comprehensive exposition of the subject in general. These are also sent free upon application. Many manufacturers, among whom may be mentioned the larger makers of gears and gear machinery, publish text books which are sold for the mere cost of publication and mailing.

How often we see an engineer spending a number of his hard saved dollars for a book which is so technicalized that he cannot understand it and which contains illustrations copied by the author from the manufacturers' publications which he probably obtained for nothing. The hustling operator now has his chance and he who makes use of his opportunities will alway be the superior of his spoon-fed brother of the school.

◆

SIZE OF THE ENGINEER'S SALARY.

THE assertion has been repeatedly made that the average salaries of steam engineers is lower in Ontario than in many other parts of America. This with a few exceptions is no doubt true and is the result of a number of contributory causes. The average manufacturer is not of a mechanical turn of mind and is much more inclined to see a direct saving in wages than a probable saving in coal, even though the latter be very much greater.

The engineer, on the other hand, is not aggressive or diplomatic in his own interests. A case has just come to our notice of one who has filled a single position for thirty-two years, has not read a technical book or a trade paper for twelve years, has not indicated his engines since 1908, and has not made a single recommendation to his firm for improvements for over twenty years. While the above is an exceptional case, and we do not cite it as a criticism, every engineer should not fail to study the interests of his employers and take advantage also of every facility and opportunity for his own personal advancement.

What the modern business man wants is figures. If it can be absolutely proved to him in figures that cannot lie, that a stoker will help pay dividends, that a steam turbine will save expensive space or that water treatment will save coal, he will become interested at once, both in the plant and in the man who runs it. If a true, accurate report be periodically and personally presented to him at judicious times showing actual savings accomplished in dollars and cents or that his plant is better managed than his neighbors, the problem of an increase of salary for the responsible party is half solved

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

STEAM BOILER ECONOMY.

By W. Kavanagh.

THE man object sought in the power plant world to-day is the economical production of steam, and in order to attain this desideratum the following requisites are necessary:—Design, capacity, setting and care. Where these four factors are closely allied economy is sure to be attained. In the plant where such factors are absent or partly so a loss must take place in the generation of steam and an uneconomical plant is the result. In general, the amount of attention given to the work of firing is very limited, any person who is capable of throwing coal on the fire being considered quite competent as a fireman.

Temperature of feed water, quality of fuel and method of using same affect, however, steam generation economy, and although we secure the services of a high-grade fireman, if the temperature of the feed water be low, the effort of the fireman to economize in fuel will be somewhat nulified. If the feed water be high in temperature and fuel of good quality be scientifically fed to the furnace, but with a large amount of air infiltrating through the boiler setting, the efforts of the fireman to economically generate steam will again be largely offset.

Where boilers are too small for the work required, they should be replaced by units of sufficient capacity so as to permit of economical steam generation. In order to illustrate the inefficiency of small boiler capacity with rapid draft, the following case is here mentioned and the figures given can be verified from actual engine-room accounts and expenses.

Small Capacity With Rapid Draft.

A certain plant taking current from a central station was equipped with two 250-h.p. water tube B. & W. boilers. For the purpose of heating the building during cold weather, one boiler was used during the entire heating season of 1910-1911, beginning Oct. 15, 1910, and ending May 15, 1911. During the above heating season 1,000 tons of coal was burned.

When the next heating season arrived, it was decided to use both boilers. The heating season began on Sept. 29, 1911, and continued to May 25, 1912; (this was the coldest winter registered in 46 years) the amount of coal burned during the period being 783 tons, No. 1 Buck being used in both cases. This showed a saving of 217 tons over the previous year when the heating season was shorter and only one boiler in use. It is interesting to note that the same firemen were employed during both seasons. The foregoing illustration serves to point out the economy of large boiler capacity and reduced draft. When the one boiler was used the damper was in nearly all cases wide open, and the fires had to be cleaned four times in 24 hours, but with the two boilers in use the fires were cleaned twice only in 24 hours. The daily average number of cans of ashes with the one boiler was 28 cans, making a monthly total of 840, while with the two boilers the monthly average was 540 cans. The daily average consumption of coal with the two boilers was practically 3.3 tons, while with the one boiler the daily average consumption was 4.7 tons.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

In both cases the coal cost $3.65 per ton, showing a saving in favor of the two boilers of $793 practically. The ashes were removed for three cents per can, the cost in the one case being $178, and in the other case $128, showing a saving of $49.56, and making the total saving to the credit of the two boilers of $842 per season. The forgeoing is ample proof that sufficient boiler capacity to do the work without being forced is an important factor in generating steam economically.

Rapid vs. Slow Draft.

The modern tendency to employ small boilers and compel them to generate large quantities of steam by reason of forced draft is evidently opposed to the idea of large boiler capacity involving the use of slow draft. The theory on which forced or rapid natural draft is built is that rapid draft breaks up the tubular column formation of the flame, compelling the latter to flatten out and strike a greater area of the boiler surface. This flattening-out of the flame is supposed to be impossible when slow draft is used. It will be noticed, however, that the modern theory does not take into consideration that important factor time.

We know from actual observation and trial that the hand can be swept through the most intense flame without injury, but should an attempt be made to move the hand slowly through the flame it will be burned. Thus we learn that time is a necessary factor in the absorption of heat and generation of steam. It takes time for heat to traverse the metal and for the water to absorb the heat. The heating effect caused by rapid draft is dependent on the continuity of the heat stream yet the greater portion of the stream escapes to the atmosphere because of the lack of time for absorption. With slow draft the heat stream is compelled to traverse the metal surface, affording opportunity for heat transmission and absorption.

Economy of steam generation is also dependent on clean surfaces. If the heating surface be coated with soot and ashes they will act as insulators and prevent transmission of heat through the metal, and not only will such coatings act to increase the cost of steam making but it also shortens the life of the boiler by reason of corrosive action. This action is rapidly increased if dampness is present on the metal surface. Of course, the interior surfaces are equally important with the outer surfaces, and it is almost needless to add the greatest economy in steam generation will be attained when the boilers are clean, of large capacity and carefully fired, and fed with the highest temperature feed water.

PACKING KINKS.

By John Thorn.

MUCH is being written about saving money in the power plant, and one thing which is costly and often needlessly wasted is packing of different kinds.

In a particular case of a feed pump, the packing in the boxes would last but a few days, and, according to the engineer, it seemed to melt away. He tried several different kinds, but they all behaved the same. An examination showed that the holes at the bottom of the stuffing boxes were larger than the rods, therefore brass rings were turned out and cut in halves as shown at (2) Fig. 1. They were made a neat fit on the rods and after being placed in the bottom of the boxes with the packing on top of them, the "melting process" ceased forthwith.

In another case, a pump rod was scored, and, as a consequence, considerable trouble was experienced in keeping the rod snug, as the packing had to be made very tight to hold the water in. As an experiment, the packing was cut, as shown at (1) in Fig. 1, and between each set of rings a sheet lead washer, cut like (4) Fig. 2, with the center hole a little larger than the rod, was placed. The writer has not yet determined for certain where the virtue of this arrangement comes in, but it cured the trouble.

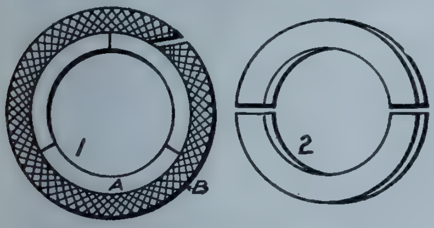


FIG. 1. PACKING KINKS.

Good packing is expensive, which fact is forgotten by many engineers in cutting it up. When a washer is required it is quite common to see a man cut a piece from a sheet several inches greater in diameter than necessary, carry the cut piece to the bench, and use the compass to mark it out. The only reason for doing the first cutting was to reduce the original stock to more convenient size for handling.

Much packing is wasted by being cut too long, which also impairs its proper working. When the gland is tightened down on ring packing with the ends touching, most of the pressure placed upon it simply forces it against the sides of the box instead of against the rod. This means that the packing must be renewed every few days.

All ring packing should be cut so that there will be a space of at least 3/16 or ¼ inch between the ends when it is on the rod, and no one cut should be placed opposite that adjacent. When lubricated plaited, square or round, flax packing becomes hard, it should be removed, washed in hot water, and thoroughly dried, after which it should be soaked in a good thin oil for an hour or two, when it will be as good as new. Several pounds of this kind of packing is often used for an outside packed pump, and it has to be replaced every month or two in numerous cases. By using the foregoing scheme, a single packing will last many months longer. An untidy but successful scheme used by one man on an outside packed pump to make the flax packing last longer was to bind a cloth, saturated with cylinder oil, at the end of the pump in such a way that the plungers continually came in contact with it when working.

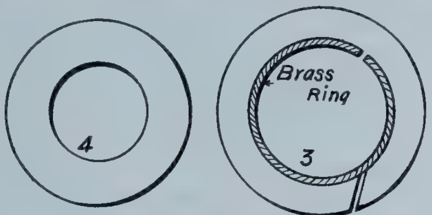


FIG. 2. PACKING KINKS.

In small feed pumps with inside packed pistons or plungers on the water end, considerable trouble is found in renewing the packing, particularly when hot water is used, as the outside of the packing rings soon wears and allows the piston to become so slack that it will not force the water. A scheme which the writer has seen used with success consisted in making some hard brass rings, which had considerable spring. These were placed over the piston with a thinner packing than usual to allow for the space the rings would take up. As the packing wore, the spring kept it in contact with the cylinder walls, as shown at (3) Fig. 2. In practice it has been found that, even with a cylinder worn larger in the center than at the ends, it will work without excessive friction. The spring causes the packing to conform in size to the different diameters of the cylinder, and the plunger is thus kept tight in all positions. Much more can be said on this subject, but the foregoing is practical, and if it helps one man out of a hole the writer will feel amply repaid.

ATTRACTIVENESS OF BALL BEARINGS.

By N. G. Near.

ONCE in a while we run across men who proudly point to bearings of their own design that are made to run without oil. Oil is not wanted on the bearings, because it might fly off and ruin the product of manufacture. In most cases, however, that have come under my observation, such bearings are not exactly satisfactory. They heat and squeak.

Ball bearings would certainly do the same work and do it much better. They require a little oil, true enough, but just enough to keep the balls and races from rusting, and are now made so rugged as to be almost as durable, and in many cases more durable, than plain bearings, as Thomas' recent tests, presented before the American Society of Mechanical Engineers, plainly indicate. In textile mills, where cleanliness is a decided necessity in order that the product of manufacture will be perfectly free from dirt and grease, ball bearings are being much used.

Ball bearings are quiet, they do not heat, they are consumers of but little space, and they are the closest approach to frictionlessness that we know of.

◆

Hamilton No. 2, C.A.S.E.—A largely-attended and enthusiastic meeting of Hamilton Lodge No. 2, C.A.S.E., was held on June 18 in the Engineers' Hall, North James Street. An initiation, followed by the election of officers for the ensuing year, and addresses by S. E. Cosford, London, Ont., executive president, and W. J. Needham, Owen Sound, Ont., formed the principal features of the evening. Officers elected are as follows:—President, A. Swazie; vice-president, L. J. Ellis; secretary, A. W. Heath; treasurer, J. Hale; conductor, W. Hullock; doorkeeper, C. Carroll; trustees, W. Denning, C. A. Leckie and H. L. Bishop; delegates to convention in Ottawa, L. J. Ellis, J. Hale and H. R. Clark; alternates, W. Denning and G. Robins.

◆

Ottawa No. 7, C.A.S E.—The following officers were elected for the ensuing year at a recent meeting:—President, A. Kastella; vice-president, George G. Lee; financial secretary, George Findlay; recording secretary, F. Davis; treasurer, J. G. A. McCurly; conductor, — Draper; doorkeeper, W. H. Thompson.

C A.S.E. ANNUAL CONVENTION.

THE twenty-fifth annual convention of the Canadian Association of Stationary Engineers will be held in Ottawa, Ont., on July 28-29-30. The business sessions and power plant equipment display, under the auspices of the Exhibitors' Association, will be held in the Ottawa Amateur Athletic Club Building, corner Laurier Avenue and Elgin Street. The following combination programme has been arranged:—

Tuesday, July 28.

2 p.m.—Grand opening, in which all visitors, including ladies, will participate. Mayor's address and responses by J. A. Robertson, Stratford; E. A. Wilkinson, Toronto, and A. Kastella, Ottawa.

3 p.m.—Automobile drive for the ladies, delegates in session, appointment of committees, secretary and treasurer report, general business.

8.30 p.m.—Banquet by Capital City Lodge.

Wednesday, July 29.

9 a.m.—General business, report of committees, election of officers.

1 p.m.—Assemble on Parliament Hill for photograph.

1.30 p.m.—Supply men's entertainment at Belle Isle Park.

In the evening an opportunity will be given the public to inspect the exhibits.

Thursday, July 30.

9 a.m.—General business, auditors' report, unfinished business.

10 a.m.—Exhibitors' Association business session.

2 p.m.—Installation of new C.A.S.E. executive and convention closing.

* * *

Sask. Brotherhood Steam and Operating Engineers. — The Saskatchewan Brotherhood of Steam and Operating Engineers have planned one of the largest and most comprehensive conventions and mechanical exhibitions ever held in the Dominion of Canada. This double function will take place on July 28, 29 and 30, in conjunction with and at the same time as the big provincial exhibition at Regina. There will be exhibits from all the leading manufacturers of and manufacturers' agents dealing in engineering supplies. In addition to the big display of engineering specialties, there will be a series of lectures on important engineering topics by some of the leading engineers of the Dominion. Coming as it does at the time of the provincial exhibition, the display will be viewed by thousands of people who would otherwise not see it.

Representatives will be present from as fas East as Ottawa, Ont., and as far West as Vancouver, B.C. A civic welcome to the engineering fraternity and the entertainment of guests will form highly important features of the convention. Information with regard to exhibit space or with reference to the convention can be had by writing the secretary, H. J. Fox, Provincial Normal School, Regina, Sask.

* * *

Montreal No. 1 C.A.S.E.—At the annual meeting of Montreal Lodge No. 1 C.A.S.E., held on June 26, in the Royal Arcanum Chambers, highly satisfactory reports of progress and of an encouraging outlook for the future were given, a condition of things going to show that this young offspring of the C.A.S.E. is destined to become both a loyal and efficient contributor to the strength of the parent body. The following officers were elected for the ensuing year:—Past president, H. L. Sackett; president, R. D. Smith; vice-president, W. G. Forbes; corresponding secretary, A. L. Jones; treasurer, J. Mitchell; financial secretary, W. H. Johnston; conductor, I. J. Tait; doorkeeper, S. Winter; trustees, J. H. Clarkson, J. Carmichael, H. L. Sackett; auditors, W. Fyfe, S. Winter, and A. F. Parker; delegates to the C..AS.E. annual convention at Ottawa, H. L. Sackett, W. G. Forbes and A. L. Jones.

* * *

Regina, Sask.—The Regina Brewing Co., Regina, Sask., have made improvements in their plant by the installation of 2,500 feet of 2-inch full weight black lap welded direct expansion piping, furnished by the Vilter Manufacturing Co., Milwaukee, Wis.

* * *

The Hawley Down Draft Furnace Co., of Easton, Penn., will furnish the furnaces for the new Rosemount School in Montreal. The Hawley Co. is represented in Quebec by the Engineers' Supply Co., No. 46 Alexander Street, Montreal.

EXECUTIVE, THE C.A.S.E. EXHIBITORS' ASSOCIATION.

Instruction Course for Power Plant Operators--III.

By M. L. Smith, B.A.Sc.

Throughout the writer's experience as a teacher, he has been continually confronted with the query: "Can you recommend a text book for power plant employees?" This, on account of specialization of the different branches of the work and the fact that most books published deal with methods of particular localities, is practically impossible. This series of articles is intended to supply the need, to set forth the technical points so that firemen and engineers can understand and apply them, and be thereby assisted in passing the various qualifying examinations.

THE student will now encounter some little difficulty in getting a clear mental picture of what takes place in cylinder and steam chest at each and every position of the crank. It will be found of great assistance to paint an outline of the ports, as shown in these cuts, upon one piece of cardboard and the valve on another. By moving the valve to different positions and marking the corresponding crank positions on a circle, the occurrences in both ends of the cylinder can be easily studied.

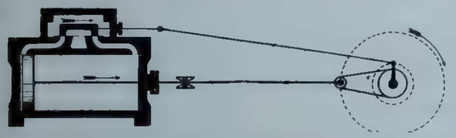


FIG. 13. VALVE WITHOUT LAP BEGINNING OF STROKE.

Steam Distribution.

As was observed in the previous article, the motion of the engine depends upon the distribution of the steam to the ports leading to the ends of the cylinder at proper times and in suitable quantities. It was also mentioned that this distribution was accomplished by means of a valve actuated from the crank shaft by means of a small crank called an eccentric. It is obvious that this eccentric must be set and fastened to the shaft in an exact relation to the crank in order to give steam to the ports at the correct times.

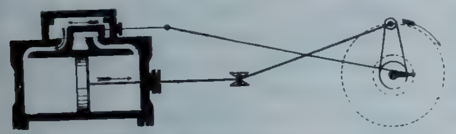


FIG. 14. VALVE WITHOUT LAP POINT OF MAXIMUM PORT OPENING.

The Simple Slide Valve.

Let us first consider the slide valve in its simplest form; that is, without lap. Its faces exactly cover the steam ports when in mid position, as shown in Fig. 13, which represents the relative positions of valve, piston, crank and eccentric at the beginning of a revolution. The piston is at the end of its stroke, the valve is at the middle point of its travel and the ports are closed.

Assume that the engine runs **over** according to the arrow. This means that the direction of rotation is such that the thrust of the connecting rod is over the center line. If the flywheel rotated in the opposite direction, the thrust of the rod would be below the center line and the engine would be running "**under.**" The slightest motion of the engine causes the valve to move, the port to open, and steam to be admitted to the "**head**" end of the cylinder. The valve continues to move to the right until the piston has reached the middle of its stroke (Fig. 14).

At this point the valve reverses and moves to the left, while the piston continues to move to the right until the end of its stroke is reached (Fig. 15), where the ports are again closed. The valve, continuing to the left, accomplishes two things, the admitting of steam to the crank ends of the cylinder and the opening of the head end to exhaust. The piston on its return stroke forces out the steam used in the forward stroke through the exhaust port, which has its greatest opening when the piston is at its mid position, as in Fig. 16. The piston now continues to move to the left, being driven by the flywheel and the live steam on its opposite side, while the valve moves to the right until its mid-position is reached. The ports are again closed and the piston has returned to the starting position. This completes a revolution or cycle of events for the engine.

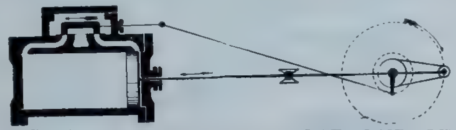


FIG. 15. VALVE WITHOUT LAP, END OF FORWARD STROKE.

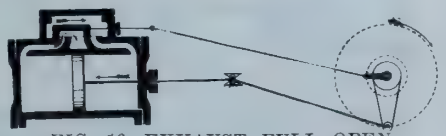


FIG. 16. EXHAUST FULL OPEN.

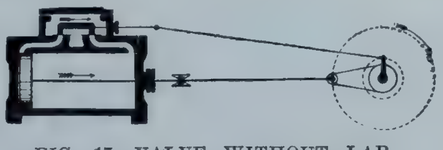


FIG. 17. VALVE WITHOUT LAP—COMPLETED REVOLUTION.

Notice that steam is admitted at the beginning of the working stroke and is exhausted at the beginning of the return stroke. In other words, live steam is used throughout the whole stroke and likewise the exhaust is open for the same length of time. Under these conditions there can be no expansion of steam in the cylinder during the forward stroke and no compression of the exhaust steam during the return stroke. The above conditions are used to a certain extent in the operation of direct acting steam pumps.

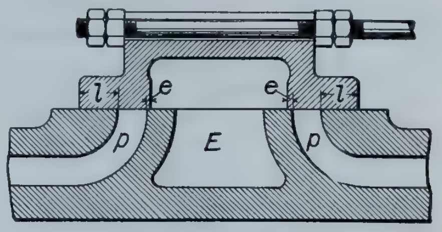


FIG. 18. LAP ADDED TO VALVE WITH OUTSIDE ADMISSION.

Addition of Lap.

As it is an extremely wasteful practice to use only the direct pressure of the steam given to it by the boiler, the valve is, in most cases, arranged to utilize a part of its expansive energy as well. This is accomplished by adding "lap."

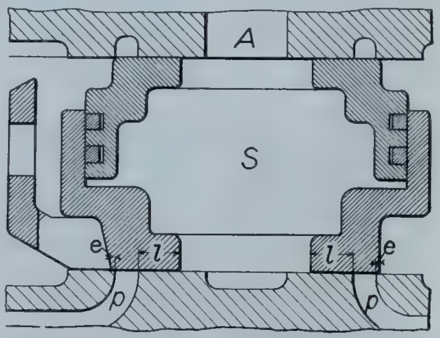


FIG. 19. LAP ADDED TO VALVE WITH INSIDE ADMISSION.

Definition.—Lap is an addition to the working edges of the valve for the purpose of cutting off the steam at some point within the stroke to allow of its expansion. It is also used for the purpose of closing the exhaust before the end of the return stroke, in order that a part of the steam may be trapped in the cylinder and used to cushion the piston.

Lap is therefore of two kinds, "**steam**" or outside lap and "**exhaust**" or inside lap. These are shown at (l) and (e) respectively (Fig. 18). Lap is equal to the amount measured in inches or parts of an inch by which the valve overhangs the edges of the ports when in mid-position.

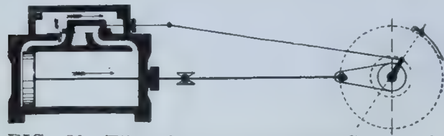


FIG. 20. EFFECT OF LAP—BEGINNING OF FORWARD STROKE.

Nearly all valves are of the above type; that is, "**outside admission.**" The boiler steam surrounds the outside of the valve, pressing it to its seat and being admitted to the cylinder past its outside edges. Some are, however, of the form shown in Fig. 19, in which the steam takes the opposite course, entering (S), being admitted by the inside edges and exhausted at the outside. An examination of the figure will show that the arrangement does not alter the amount of either steam or exhaust lap. This type is known as "**inside admission**" and is usually applied to valves of the piston class.

Effects of Lap.

The valve, with lap added to it, produces two distinct events in the engine revolution in addition to admission and release, which were accomplished by the valve without lap. The order of the events is now, therefore—(1) The point of "**admission**" where the valve begins to open and steam to enter cylinder; (2) the point of "**cut off**" where port closes and steam drives the piston by expansion; (3) the point of "**release**" where ports are opened to exhaust; and (4) where exhaust again closes at the point of **compression** and remaining steam serves as a cushion for the reciprocating parts.

Observe in Figs. 13-17, where the valve is without lap, that the **eccentric center** is set at right angles to the crank center. The addition of lap necessitates a slightly different arrangement, as is shown in Figs. 20-25. The valve must be placed a little farther ahead of the crank on account of the lap in order to open the port at the beginning of the engine stroke. Fig. 20 shows the engine on the **dead center** at the beginning of the revolution. The port is already slightly open and steam is entering the head end. The point of admission occurs slightly before the beginning of the stroke.

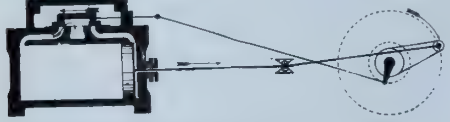


FIG. 23. EFFECT OF LAP—POINT OF RELEASE.

Both piston and valve move to the right until the point of "**maximum** port opening" is reached (Fig. 21). From this point the valve returns and at the point of cut off (Fig. 22) the port is closed and no more live steam is used for this stroke. The piston finishes the stroke on the expansion of the steam now in the cylinder and, although its pressure is gradually falling, it does considerable work.

Slightly before the end of the stroke the port is opened to exhaust by the inside edge of the valve, and **release** occurs (Fig. 23). The piston now returns, pushing the steam before it until the point of **compression** is reached (Fig. 24). Here the inside lap of the valve again closes the port, and the steam left in the cylinder, being unable to escape, serves to stop the piston in preparation for the next stroke forward. The pressure of the entrapped steam is raised, in this way, to about one-third the boiler pressure, and assists the live steam to fill the clearance space. Admission takes place next, and just before the end of the stroke, so that ports and passages may be full of steam at boiler pressure when the piston is at the end of the cylinder and ready to perform the next revolution (Fig. 25).

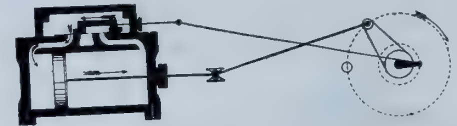


FIG. 21. EFFECT OF LAP—POINT OF MAXIMUM PORT OPENING.

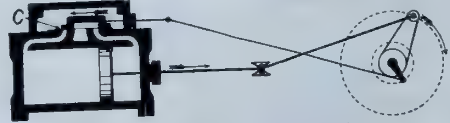


FIG. 22. POINT OF CUT-OFF.

The time between admission and cut-off is called the "**period of admission**; between cut-off and release it is called the "**period of expansion**"; from release to compression it is known as the "**period of exhaust**" and from compression to admission is known as the "**period of compression.**"

Valve Travel.

Notice particularly:—(1) That, in the case of a valve without lap, the "**travel**" required is equal to twice the width of one steam port; (2) that, in the case of a valve having lap, the "**travel**" will have to be twice the width of one port plus twice the steam or outside lap; (3) that the "**throw**" of the eccentric is one-half the valve travel; (4) that, when the eccentric is "**directly connected**" to an outside admission valve stem it is always set "**ahead**" of the crank. The student will observe further that the effect of outside lap is to produce a cut off, the greater the lap the earlier the cut off. The effect of inside lap is to make release "**later**" and compression "**earlier**" in proportion to the amount of lap used.

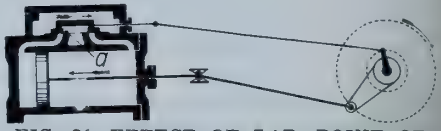


FIG. 24. EFFECT OF LAP—POINT OF COMPRESSION.

The next article of this series will deal with valve setting.

◆

CONFERENCE ON UNIFORM BOILER REGULATIONS.

A CONFERENCE on uniform regulations for the construction and inspection of steam boilers was recently held in the Parliament Buildings, Toronto, Ont. The delegates composing the conference consisted of D. M. Medcalf, Ontario; John Peck, British Columbia; R. N. Blackburn, Saskatchewan; P. J. Tobin, Quebec; and W. G. Matheson, Nova Scotia.

Sittings commenced on June 16 and lasted intermittently until July 4, during which time the regulations in force in the provinces of British Columbia, Ontario, and Saskatchewan were discussed in detail, and uniform regulations agreed upon. A draft of the proposed code will be submitted to Manitoba, Quebec, New Brunswick and Nova Scotia, where legislation has been passed bringing an act into force as soon as boiler inspection rules have been approved. Alberta has already a code in force, but was not represented at the conference. This province has, however, expressed its intention of conforming to that drafted by the interprovincial conference, thus making recognition of the certificate uniform throughout the Dominion.

Several visits to works were made by the delegates. These included the Canadian Locomotive Co. plant at Kingston; Montreal Locomotive Works, Montreal; Goldie & McCulloch & Co., Galt.; Watson's Engine Works, Brantford; Leonard & Sons, London; Jeneckes Machine Co., St. Catharines; the Sawyer-Massey Co., Hamilton; and a visit to Niagara Falls. A deputation from the Canadian Manufacturers' Association, Toronto, addressed the conference. It was decided to hold a general conference each year in future.

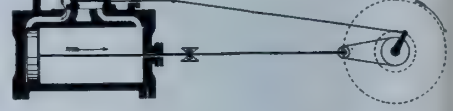


FIG. 25. EFFECT OF LAP, COMPLETION OF ONE REVOLUTION.

Arithmetic for the Machinist and Operative-Engineer

By J. H. Rodgers

With the further development of this course in arithmetic, it will be found by those who have followed the introductory lessons and profited by them that the various practical applications resulting from the succeeding lessons will be easily observed and their time and labor-saving features so appreciated as to be adopted at every available opportunity.

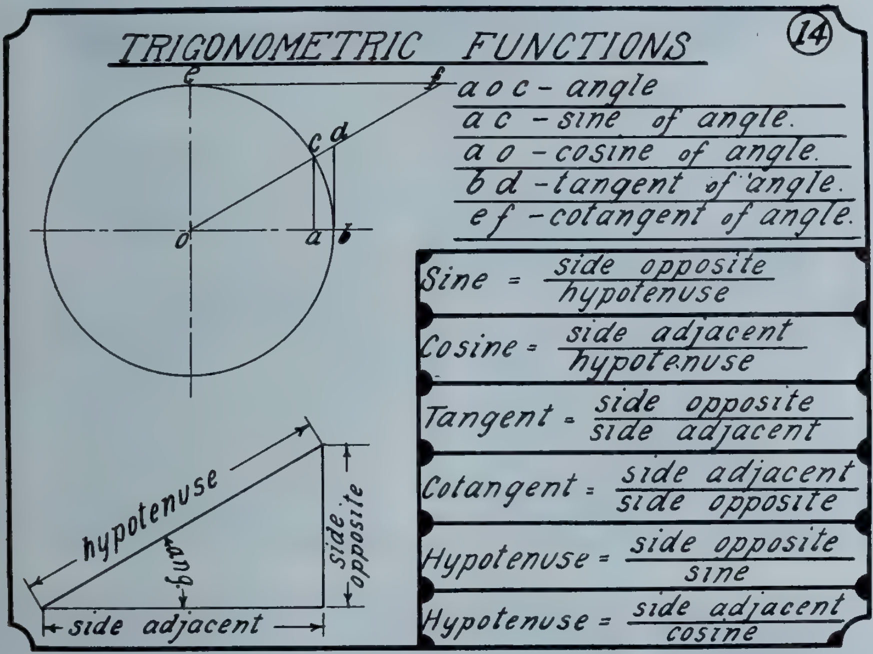
TRIGONOMETRY.

MATHEMATICS which treats of the solution of triangles is called trigonometry.

Every triangle has six parts--three sides and three angles.

An angle, usually, is the opening between two radii of a circle, the circle being assumed as divided radially into 360 equal parts called degrees; each degree being again divided into 60 minutes, and each minute further divided into 60 seconds. It is evident that a 1° arc in two circles of different radii will be of different length, but will be proportional as the length of the radii. In trigonometry, the arcs of circles are used to measure angles.

In the solution of right triangles, the base (o b), Chart 14, is generally assumed to be in a horizontal position, the vertex (o) being in the centre of the circle, and the point (b), the starting point in measuring the angle. When adding two or more angles together, seconds are added to seconds, minutes to minutes and degrees to degrees.



$$\text{Sine} = \frac{\text{side opposite}}{\text{hypotenuse}}$$

$$\text{Cosine} = \frac{\text{side adjacent}}{\text{hypotenuse}}$$

$$\text{Tangent} = \frac{\text{side opposite}}{\text{side adjacent}}$$

$$\text{Cotangent} = \frac{\text{side adjacent}}{\text{side opposite}}$$

$$\text{Hypotenuse} = \frac{\text{side opposite}}{\text{sine}}$$

$$\text{Hypotenuse} = \frac{\text{side adjacent}}{\text{cosine}}$$

ARITHMETIC CHART 14.

Trigonometric Functions.

A function of a quantity is another quantity which depends upon the first one for its value. The principal functions of trigonometry are the sine, cosine, tangent and cotangent.

The sine of an angle is the line (a c) drawn perpendicular to the base (o b), to the extreme end of the hypotenuse, when the hypotenuse is the radius of the circle.

The cosine of an angle is the distance (o a) from the foot of the sine to the centre of the circle or vertex of the angle.

The tangent of an angle is the line (b d) drawn perpendicular to the base to the extreme end of the hpyotenuse, when the base (o b) is the radius of the circle.

The line (e f), drawn from the extreme end of the vertical radius and parallel to the base (o b) to meet the hypotenuse or hypotenuse produced, is called the cotangent of the angle.

If the values of the various functions be known for any angle in a circle whose radius is one, their values for the same angle in any other circle can be obtained by multiplying their known values by the radius of the required circle. Conversely, if the value of any of the functions be known for an angle in a circle whose radius is other than one, the value for the same angle in a circle whose radius is one can be obtained by dividing the known values by the radius of the given circle. Chart 15 gives the values of the four principal functions, in even degrees.

The values of 1° to 45° are given in a descending order, and those from 45° to 90° are found by reading from the bottom upwards. Approximate values of fractional degrees are found by the two formulas at the foot of the table.

Example:—Required the sine of an angle of 36° 45′. From table, Chart 15, $a^\circ = 36^\circ$.

Sine of a° or $36^\circ = .58779$
Sine of $a^\circ + 1^\circ$ or $37^\circ = .60182$

$d = .01403$

TRIGONOMETRY.

°	sine	cosine	tangent	co-tangent	°
1	·01745	·99985	·01746	57·2900	89
2	·03490	·99939	·03492	28·6363	88
3	·05234	·99863	·05241	19·0811	87
4	·06976	·99756	·06993	14·3007	86
5	·08716	·99619	·08749	11·4301	85
6	·10453	·99452	·10510	9·51436	84
7	·12187	·99255	·12278	8·14435	83
8	·13917	·99027	·14054	7·11537	82
9	·15643	·98769	·15838	6·31375	81
10	·17365	·98481	·17633	5·67128	80
11	·19081	·98163	·19438	5·14455	79
12	·20791	·97815	·21256	4·70463	78
13	·22495	·97437	·23087	4·33148	77
14	·24192	·97030	·24933	4·01078	76
15	·25882	·96593	·26795	3·73205	75
16	·27564	·96126	·28675	3·48741	74
17	·29237	·95630	·30573	3·27085	73
18	·30902	·95106	·32492	3·07768	72
19	·32557	·94552	·34433	2·90421	71
20	·34202	·93969	·36397	2·74748	70
21	·35837	·93358	·38386	2·60509	69
22	·37461	·92718	·40403	2·47509	68
23	·39073	·92050	·42447	2·35585	67
24	·40674	·91355	·44523	2·24604	66
25	·42262	·90631	·46631	2·14451	65
26	·43837	·89879	·48773	2·05030	64
27	·45399	·89101	·50953	1·96261	63
28	·46947	·88295	·53171	1·88073	62
29	·48481	·87462	·55431	1·80405	61
30	·50000	·86603	·57735	1·73205	60
31	·51504	·85717	·60086	1·66428	59
32	·52992	·84805	·62487	1·60033	58
33	·54464	·83867	·64941	1·53986	57
34	·55919	·82904	·67451	1·48256	56
35	·57358	·81915	·70021	1·42815	55
36	·58779	·80902	·72654	1·37638	54
37	·60182	·79364	·75355	1·32704	53
38	·61566	·78801	·78129	1·27994	52
39	·62932	·77715	·80978	1·23490	51
40	·64279	·76604	·83910	1·19175	50
41	·65606	·75471	·86929	1·15037	49
42	·66913	·74314	·90040	1·11061	48
43	·68200	·73135	·93252	1·07237	47
44	·69466	·71934	·96569	1·03553	46
45	·70711	·70711	1·0000	1·00000	45
°	cosine	sine	co-tangent	tangent	°

a° = angle, less m ; a_1° = angle
f = function of a° ; f_1 = function of a_1°
d = difference between f and f of $(a^\circ + 1^\circ)$
d_1 = " " f and f_1
m = minutes.

$$a_1^\circ = a^\circ + \left(\frac{d_1}{d} \times 60\right)^{\text{min.}} \qquad f_1 = f \pm \left(\frac{m}{60} \times d\right) *$$

* If sine or tangent, add the expression, $\left(\frac{m}{60} \times d\right)$.
If cosine or cotangent subtract the expression.

⑮

ARITHMETIC CHART 15.

Then by formula,

$$f_1 = f \pm \left\{ \frac{m}{60} \times d \right\} = .58779$$

$$+ \left\{ \frac{45}{60} \times \frac{.01403}{1} \right\} = .58779 + .01052$$

$$= .59831 = \text{Sine of } 36^\circ\ 45'$$

Example:—Required the cosine of the angle 65° 36′.

f = cosine of a° or 65° = .42262
f of $a^\circ + 1$ = cosine of 66° = .40674

d = .01588

Then by formula,

$$f_1 = f \pm \left\{ \frac{m}{60} \times d \right\} = .42262$$

$$= \left\{ \frac{36}{60} \times \frac{.01588}{1} \right\} = 42262 - .00953$$

$$= .41309 = \text{cosine of angle of } 65^\circ\ 36'$$

Again:—Required the angle whose tangent is 2.82436.

a°_1 = required angle.

Looking in table, we find that this number falls between the angles 70° and 71°, then

tangent of a° or 70° = 2.74748
tangent of $a^\circ + 1^\circ$ or 71° = 2.90421

d = 15673
d_1 = 2.82436 — 2,74748 = .07688

By formula,

$$a^\circ_1 = a^\circ + \left\{ \frac{d_1}{d} \times 60 \right\}^{\text{min.}} =$$

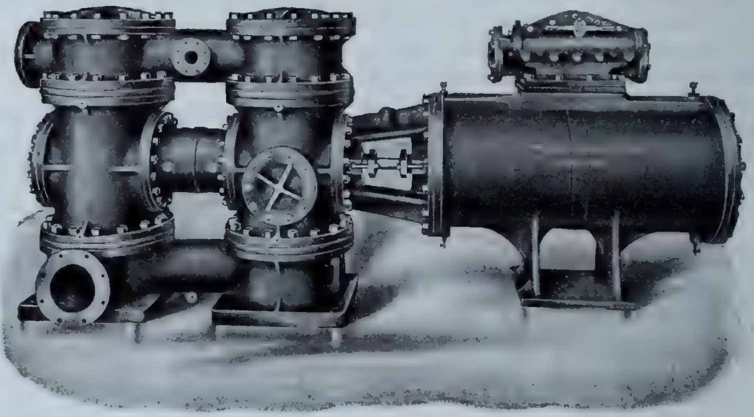
$$70^\circ + \left\{ \frac{.07688}{15673} \times \frac{60}{1} \right\}^{\text{min.}} = 70^\circ\ 30' \text{ nearly.}$$

* * *

FIRE TUG PUMP TEST.

FOR fire protection purposes along Toronto harbor front and across the bay at the Island, the tug T. J. Clark has had installed a Bawden patent compound, single stroke, double-acting steam pump, having high pressure group valve type water end. The duty requirement was 1,000 gallons per minute against 580 ft. head; with steam of 135 pounds per sq. inch on the piston of the high pressure steam cylinder. The pump cylinders are 14 in. and 24 in. diameter at the steam end, 12 in. diameter at the water end; the stroke of all being 20 inches. Bawden steam operated piston valves are fitted to the steam cylinders.

Tests of the pump were made at Centre Island on May 13, in the presence of Fire Chief Thompson and other officials, the results of which were highly satisfactory to all concerned; the required capacity being attained against a head of 635 feet. Test No. 1 consisted of pumping through two 500 ft. lengths of $2\frac{1}{2}$-in. hose, fitted with $1\frac{1}{4}$-in. nozzles. Test No. 2 consisted of pumping through two 750 ft. lengths of $2\frac{1}{2}$-in. hose, also with $1\frac{1}{4}$-in. nozzles; each of which threw a steady non-pulsating stream of 164 feet.


BAWDEN PATENT COMPOUND SINGLE-STROKE DOUBLE-ACTING STEAM PUMP.

Although this type pump was illustrated and described in a former issue of **The Power House**, it may not be out of place to again draw attention to the more prominent features of this Bawden pump. The high and low pressure pistons work in one steam cylinder, while the steam ports are short and so arranged that the exhaust from the high pressure cylinder to the low pressure cylinder never leaves the main cylinder casting. Radiation and condensation are thereby reduced to a minimum. Only one steam chest is required, one valve distributing the high and low pressure steam. Owing to the absence of all external valve gearing, a high piston speed may be got if required, and during the progress of the foregoing tests as high as 172 ft. per minute was recorded.

* * *

Boving Co. Vindicated. — Lumber-choked impellers and sand accumulation do not necessarily contribute to material strength, capacity or efficiency of centrifugal pumps. In the case of such machines installed at the main pumping station, Toronto, by the Boving Co. of Canada, Ltd., the combination failed. Capacity and efficiency were crippled, and necessarily so. The pumps were designed to handle water, and on test showed that they could do so in excess of every guarantee, yet because for a time, elements foreign to their purpose were allowed to exist in the interior mechanism, steps were being taken to bring the contractors to book for non-attainment in the guarantee period. The Boving Co. are to be congratulated on having vindicated themselves, the onus of the trouble being on the other side.

TESTS OF BAWDEN PATENT COMPOUND SINGLE-STROKE DOUBLE-ACTING STEAM PUMP AT TORONTO ISLAND.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent, practical questions, and give same direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

PROBLEMS IN CENTRIFUGAL FORCE.

CENTRIFUGAL Force is the force which tends to move a body away from the centre about which it rotates. It is caused by the tendency of a body to move in a straight line rather than in a circle.

The formula for centrifugal force is

$$F = \frac{mv^2}{R}$$

In which m = the mass of the revolving body.

v = the velocity of its centre of gravity in feet per second.

R = radius = the distance between the centre of gravity of the body and the centre of motion.

For pulleys and other parts of machinery, this formula is best simplified so that we can use r.p.m. instead of ft. per sec., and weight in pounds instead of mass.

$$m = \text{mass} = \frac{W}{g}$$

where W = total weight of body in pounds.

g = value of the force of gravity = 32.16.

$$N = \frac{60v}{2 \times 3.1416 \times R},$$

there being 60 seconds in one minute, and the circumference of a circle = 3.1416 × 2 × radius. N = r.p.m.

Combining these values, from

$$F = \frac{m}{R}v^2, \text{ we get } F = \frac{W}{gR}\left\{\frac{2 \times 3.1416 \times R \times N}{60}\right\}^2 = .00034W\,RN,^2$$

which is a more workable form of the formula for most purposes, and in which

W = weight of the rotating body in pounds.

R = radius of motion.

N = revolutions per minute.

Question.—What would be the total centrifugal force developed in a cast iron flywheel whose outer diameter is 5 ft. 3 in.; thickness of rim, 3 in.; width of face 12 in., and speed 190 r.p.m.?

Answer.—It is usual to consider the rim only in such cases, therefore number of cubic inches of iron in rim = cross section area × mean circumference = $(3 \times 12) \times (5 \times 12 \times 3.1416)$.

Weight = $6785.8 \times .26 = 1764.32$ pounds.

Using formula $F = .00034WRN^2$,

$F = .00034 \times 1764.32 \times 2.5 \times 190 \times 190 = 54{,}138.16$ pounds, which is the total centrifugal force tending to separate the rim from the hub.

* * *

Question.—If a ten-foot pulley were one pound out of balance, at what speed would it have to be run in order to make the unbalanced centrifugal force equal to a ton?

Answer.—Using the formula $F = .00034WRN^2$, we desire to find N, therefore

$$N^2 = \frac{F}{.00034WR} \text{ or } N = \sqrt{\frac{F}{.00034WR}}$$

Substituting values,

$$N = \sqrt{\frac{2000}{.00034 \times 1 \times 5}} = \sqrt{1176470} =$$

1080 revolutions per minute. That is, at 1,080 r.p.m., the pulley would be a ton out of balance.

* * *

Question.—The Quebec bridge will weigh when completed approximately 65,000 tons. What would you expect it to weigh if the earth ceased to rotate and there was no centrifugal force?

Answer.—Formula, $F = .00034WRN^2$.

$W = 65{,}000$ tons $= 65{,}000 \times 2{,}000$ lbs.

$R = 4{,}000$ miles $= 4000 \times 5{,}280$ ft.

$N = 1$ revolution per day $= \frac{1}{24 \times 60}$ revolutions per minute.

Therefore,

$$F = \frac{.00034 \times 65{,}000 \times 2000 \times 4000 \times 5280}{24 \times 60 \times 24 \times 60} =$$

450,185.3 pounds = 225.1 tons; or, if it were not for this force, the bridge would weigh 65,000+225.1=65,225.1 tons.

* * *

Question.—The governor weight of an automatic cut-off engine weighs 120 lbs., and its working position is 9 inches from the outside edge of a 4-ft. wheel. The action of the weight is directly resisted by a coiled spring. If the speed be 280 r.p.m., and friction be neglected, what will be the tension of the spring?

Answer.—Formula:

$F = .00034 \times WRN^2$.

$R = 2 \text{ ft.} - 9 \text{ in.} = 1\tfrac{1}{4} = \frac{5}{4}$ feet,

or $F = .00034 \times 120 \times \frac{5}{4} \times 280 \times 280$

$= 799.68$ pounds.

Question.—If a car weighing 30,000 lbs. went round a curve of 60-ft. radius at the rate of fifteen miles per hour, what would be the force tending to throw the car off the track?

Answer. — The original formula $F = \frac{mv^2}{R}$ is most convenient in this case.

$$m = \frac{\text{weight}}{\text{force of gravity}} = \frac{30000}{32.16}$$

$$v = 15 \text{ miles per hour} = \frac{15 \times 5280}{60 \times 60} = 22$$

ft. per sec.

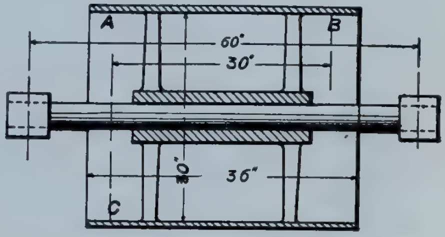
$R = 60$ ft., therefore,

$$F = \frac{30{,}000}{32.16} \times \frac{22 \times 22}{60} = 7524.8 \text{ pounds},$$

or 3.76 tons.

* * *

Question.—An idler pulley of 36-in. face and 31-in. diameter, with rim 1-in. thick, is two pounds out of balance on account of a lump at C in the cut. The man who balanced the pulley attempted to correct this by putting a two-pound weight upon the opposite side of the pulley at B, instead of at A as he should have done. Considering the weights 30 in. apart and the bearings 60 in. apart, what would be the force on each bearing due to the wobble of the pulley when running at 1,000 r.p.m.?



PROBLEM IN CENTRIFUGAL FORCE.

Answer.—For one bearing, centrifugal force due to 2 lbs. = $F = .00034\ WRN^2$.

$W = 2$, $R = \frac{15}{12}$ ft., $N = 1000$.

$F = .00034 \times 2 \times \frac{15}{12} \times 1000 \times 1000 = 850$ pounds.

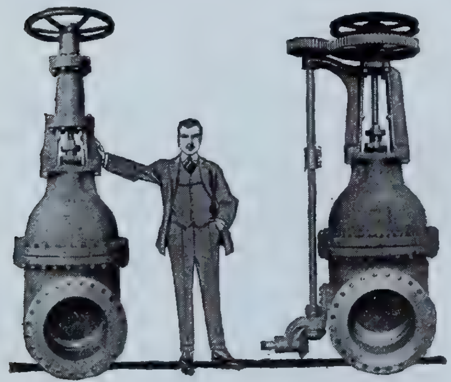
This acts at a point 15 in. from the centre of the bearing, and the shaft being pivoted at the other bearing, the force on the bearing would be $\frac{850 \times 45}{60} =$ 637.5 pounds.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

GATE VALVES FOR N.Y. EDISON COMPANY.

PERHAPS the largest steel gate valves for superheated steam yet installed in any of the immense power plants of the American metropolis are those recently built by the Nelson Valve Co., of Philadelphia, for the New York Edison Co., New York City. That these valves are strictly in keeping with the proportions of this, one of the largest public service plants in the world is best shown by the photograph in which an ordinary man appears but a dwarf when compared to the valves beside him. Seven of these valves of the two types shown were built and shipped by the Nelson Valve Co. in fifty days from the receipt of the order, a remarkable record when it is considered that new patterns had to be made throughout.



GATE VALVES FOR N. Y. EDISON CO.

Each valve, from top of stem, when valve is open, to bottom of body, stands 9 feet 1 inch in height, and the two types weigh 3,600 and 3,900 lbs. respectively. The valve shown at the left of the photograph is hand operated, though made with a large bushing just below the hand wheel, which may be removed for attachment of spur gears, if desired. The left hand valve is fitted with spur gears, bevel gears and chain for chain operation. The New York Edison Co. will install this valve on a vertical pipe line and run the extension stem, (to which is attached a bevel gear) through a wall for operating from another room. This valve can also be operated by chain, the chain wheel being attached directly to the valve stem. These valves will be used by the New York Edison Co., on header lines, 200 lbs., pressure and 150 degrees superheat.

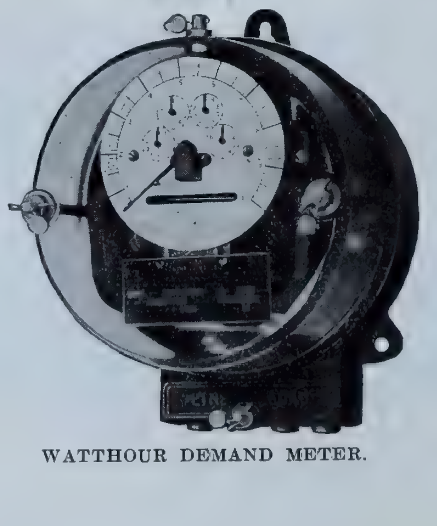
Regarding the details of construction, the Nelson Co. say: — The valves have steel body and bonnets, with seat and disk wings of forged Monel metal and stem of rolled Monel. Guides in both bonnets and body are machined, also wing lugs on the gate disks. Bracks are provided on the inside of the yoke to support the gland when repacking the stem, while eye bolts at the top of the bonnet, swing out of the way so that the valve may be repacked.

Both the steel and Monel metal used in these valves have a tensile strength of over 65,000 pounds per square inch, and the coefficients of expansion of the two metals is practically the same. This last point is an important one, since with the great changes in temperature where superheated steam is used, the expansion and contractions will cause a loosening of the seat rings, and other parts were this point not taken into consideration and provided for.

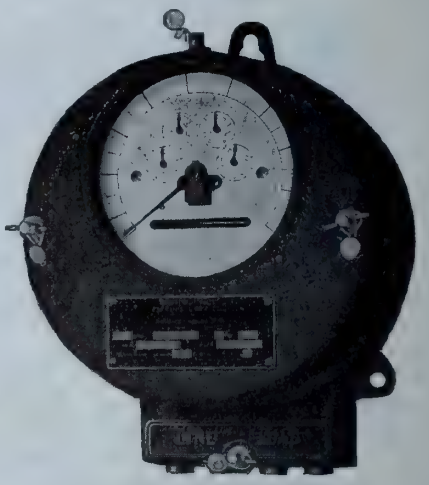
◆

WATT-HOUR DEMAND METERS.

FOR many years electric energy was sold altogether at a rate of so many cents per kilowatt-hour used, the rate depending solely on the quantity. Recent years have, however, seen a very decided change in this method of selling, and other factors are now given due consideration, the most important of these being the amount of energy called for or the demand. There has, therefore, arisen a need for a watt-hour meter to measure this value.



WATTHOUR DEMAND METER.



WATTHOUR DEMAND METER.

Such a demand meter, known as the type RO, has been recently placed on the market, its purpose being to meet the growing need on the part of central stations for an instrument to determine by a simple reading the maximum demand of an installation. This is a single meter which records without the use of a clock mechanism both the kilowatt-hours consumed and the maximum kilowatt demand. Fulfilling both these purposes, it is an ideal meter for determining maximum demand and load factor as a basis for rates, as well as the diversity factor of the station. It provides precisely the readings needed on systems that base their charges on maximum demand and power delivered. Both readings can be taken monthly. The meter records the maximum demand of the connected load, but not the time at which the maximum occurs.

The watt-hour demand meter is installed in the same manner as an ordinary watt-hour meter, and requires no additional apparatus or wiring. The maximum demand is indicated by a pointer sweeping over a 4-inch dial, and the watt-hour load is recorded on a 4-dial counter. The instrument has no clock, contacts, or other delicate parts that are likely to require attention. and the mechanism is so simple that maintenance costs are but little more than those of watt-hour meters.

The meter is a combination of an induction watt-hour meter, an induction watt-meter, and an escapement form of time element. It has a standard Westinghouse Electric Co. type OA watt-hour meter movement, including electromagnet, permanent-magnet and aluminum disk, and, in addition, has an auxiliary disk sector supported on a jewel-and-ball bearing, so that it can move in the air-gap of the electromagnet in such a manner that it does not interfere with the accuracy of the main disk, which always rotates at a speed proportional to the load. The rotation of the auxiliary disk is restrained by a spiral spring, making its final deflection proportional to the watts load. The auxiliary disk with its spring and pointer constitute an indicating watt-meter.

The shaft of the auxiliary disk is geared to an escapement wheel, and the claw restricting this wheel is oscillated by an eccentric on the main shaft. The auxiliary disk, therefore, advances step by step at a speed determined by the speed of the main watt-hour meter disk—that is, at a speed proportional to the load. It continues to advance until the spring tension balances the torque produced in the auxiliary disk. The demand mechanism is then in equilibrium and the pointer indicates the watts.

As the total deflection and the rate of deflection of the auxiliary disk vary in direct proportion, the time required to reach the maximum position when any constant load is passed through the instrument is a constant. For example, if a load of 500 watts is supplied to a 5-ampere, 100-volt meter with 15-minute time element, the demand mechanism will reach equilibrium at the 500-watt point in fifteen minutes. If instead, however, a load of 1,000 watts is applied to the meter, the demand mechanism will have to move twice as far to the 1,000-watt point, to reach equilibrium; but the double load will move the watt-hour disk twice as fast, causing the escapement to allow the demand disk to move twice as fast, and it will cover the double arc in the same time. A mathematical analysis of the instrument shows that the deflection for any varying load that does not continue long enough for the instrument to reach equilibrium is equal to the average load during the interval.

The auxiliary disk drives the demand pointer through a dog, and a fine-toothed ratchet and pawl holds the demand pointer in the position of maximum deflection until released by hand. A second ratchet and pawl allows the auxiliary disk to fall back to equilibrium under its spring tension if the load falls below that corresponding to its position at any moment, but prevents it from advancing except as controlled by the escapement as before. The maximum demand pointer can be re-set instantly by pressing a sealed button on top of the cover. This raises the pawl that holds the pointer in its maximum position, and a light spring returns the pointer to zero or to the position of the auxiliary disk.

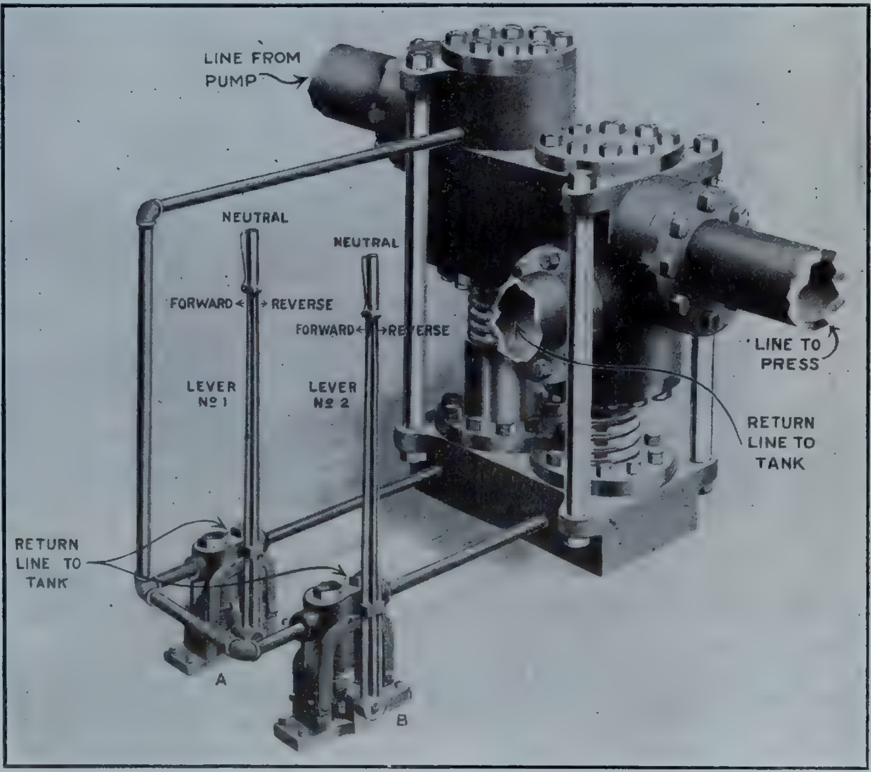
The type RO watt-hour demend meter is made by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

◆

PILOT OPERATED HYDRAULIC POPPET OPERATING VALVE.

THOSE who operate high pressure hydraulic presses requiring a very large volume of water find it difficult to obtain an operating valve which has sufficient internal areas for this service and one which can be easily controlled. It is an easy matter to design a valve with large openings and large valve seat areas, but the difficulty arises in its manipulation. For high pressure, where a large volume of water is required, the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, have designed and are putting upon the market the Hydraulic Three Way Pilot Operated Poppet Operating Valve shown by the accompanying illustration. This valve has a steel body and is designed for a pressure of 5,000 pounds per square inch and upwards. It has double checks and flanged connections. Special gun metal bronze is used in constructing the valve seats and checks, while the operating cylinder, glands and rams are cast of steel.

This type of operating valve is controlled by means of two small pilot valves. These are marked A and B in the illustration and are necessary on account of the large area of the main valve openings. These controlling operating valves need not be located near the main valve as shown in the illustration, but may be located at any point convenient. The main valve may be located under the press next to the cylinder and out of sight and yet be controlled by the pilot valves which are located at any convenient place on the floor. This is a feature often overlooked by operators of hydraulic equipment.



PILOT OPERATED HYDRAULIC POPPET OPERATED VALVES.

The main valve has three openings and four positions. The first applies the pressure to the press; the second holds the pressure on the press, line and pump; the third holds the pressure on the pump and line and relieves it from the press, while the fourth position relieves the pressure from both the press and pump. The method of obtaining the four positions is described as follows:

Position No. 1, lever No. 1 should be forward and lever No. 2 reverse.

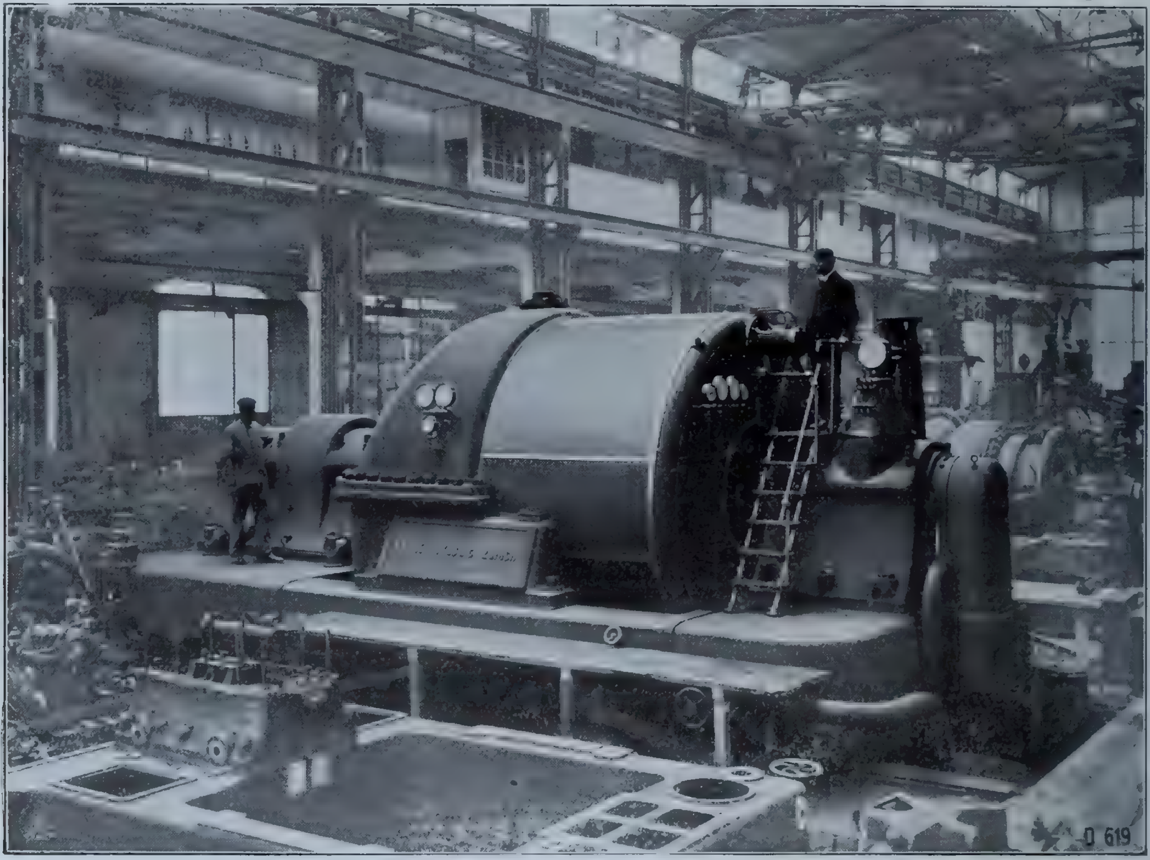
Position No. 2, lever No. 1 reverse and lever No. 2 reverse.

Position No. 3, lever No. 1 reverse and lever No. 2 forward.

Position No. 4, lever No. 1 forward and lever No. 2 forward.

Either of these pilot valves used to operate this poppet operated valve may be employed singly to control the operation of an hydraulic press which requires a medium amount of pressure. Each valve has three openings, two checks and three positions. When used singly to control the pressure on a single hydraulic press their operation is described as follows:

The middle position is neutral. With the valve in this position, the pressure is held on the pressure line and the return line from the press is closed. In the forward position, the pressure is applied to the press and the return line is closed. In the reverse position, the opening from the pressure line is closed, the pressure is held on the line, and the press cylinder is open to the return line. This type of pilot valve is suitable for use where the pressure is to be held on the line, but not where the pump is to run free while the pressure is held on the press.



15,000 K.W. ZOELLY STEAM TURBINE.

* * *

THE ZOELLY STEAM TURBINE.

IN 1898 Mr. Zoelly designed a new type of steam turbine which resembled in many respects a water turbine of the impulse type. This machine was designed on the radial flow principle, the blades not being curved. A second machine with curved blades, however, gave better results, the steam in this case striking against the rotor blades in radial direction. The principle of the impulse type has been adopted as being the best, and the only alterations that took place were in the manner of guiding the steam onto the wheels. The Zoelly turbine has gone through many stages of improvement which, however, have been solely of a constructional character, no departure from the adopted principle having taken place.

The Zoelly turbine has, in the past, been subjected to a good deal of criticism respecting the steam pressure and temperature in the first stage which were considered to be excessively high and were supposed to have a deleterious effect upon the stuffing boxes. In the case of the present Zoelly machine these criticisms are without foundation as in the first stage a greater pressure drop and likewise a correspondingly higher steam velocity is made use of than previously. This velocity equals or even surpasses that of sound corresponding to the steam conditions of this particular stage.

In order to be able to construct large units without having to employ too large blades in the last two stages, these stages are provided with a greater drop of pressure, so that they also work with steam velocities which may be 5 and even more per cent. higher than the velocity of sound. The intermediate pressure stages work with steam velocities which do not or only in a very slight degree exceed the velocity of sound belonging to the conditions of these stages. At any rate, the excess of velocity over that of sound is in the intermediate stages never so great as in the first and last stages.

The total drop of pressure available has been divided up in such manner that it has been possible to reduce the number of stages and thereby shorten the turbine by an appreciable amount. If necessary, these stages are constructed with expanded guide channels or nozzles. This expansion is not, however, designed for full load, but only part load, i.e., about half or a quarter of full load, in order to insure a good efficiency even at part full load. Such types of Zoelly have been built since the year 1908. The characteristic feature of the Zoelly turbine has always been the design of the runner wheels and guide channels in the diaphragm, the former of which in spite of the high factor of safety required, are enabled to give a relatively high circumferential velocity. Consequently greater latitude is permissible in regard to the number of stages and speed of the steam in each case.

Construction of the Zoelly Turbine.

The Zoelly turbine has from the commencement always been constructed with a horizontal shaft: experience with water turbines having shown that by this

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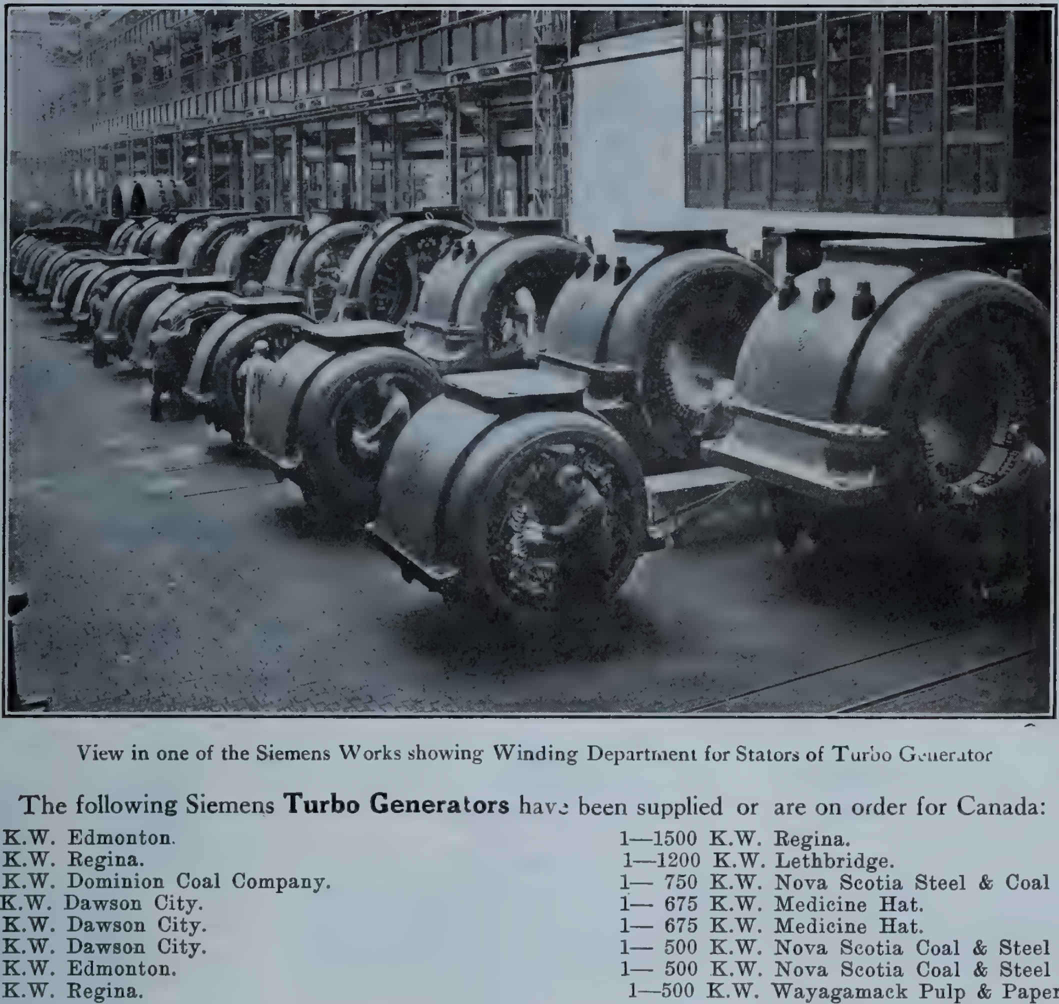

View in one of the Siemens Works showing Winding Department for Stators of Turbo Generator

The following Siemens **Turbo Generators** have been supplied or are on order for Canada:

1—4000 K.W. Edmonton.
1—3000 K.W. Regina.
1—2500 K.W. Dominion Coal Company.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Edmonton.
1—1500 K.W. Regina.
1—1500 K.W. Moose Jaw.
1—1500 K.W. Regina.
1—1200 K.W. Lethbridge.
1— 750 K.W. Nova Scotia Steel & Coal Company.
1— 675 K.W. Medicine Hat.
1— 675 K.W. Medicine Hat.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1—500 K.W. Wayagamack Pulp & Paper Company.

The Siemens Companies manufacture Turbo Generators in single units of 30,000 H.P.

Siemens Company of Canada Limited

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Transportation Building - MONTREAL

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The advertiser would like to know where you saw his advertisement—tell him.

method the simplest form of bearing can be used, permitting an easy inspection at all times. In the case of turbines running at 3,600 revolutions per minute a flexible shaft is used, so that the critical speed is sufficiently below the working speed; but in the case of turbines running at 1,800 revolutions per minute and under, the contrary is the case, the shaft is rigid and the critical speed is above the working speed. The shaft is supported by two bearings which are lubricated by oil under pressure, and is connected by means of a rigid or flexible coupling (usually rigid) to the generator or machine to be driven. The casing is built up in two halves, the joint being horizontal, so that the rotor can easily be inspected without dismantling the bearings. An idea of the accessibility of all the important parts can be gained from the illustration shown.

The impulse type allows large clearances in radial and axial direction. The axial clearances of the runner blades as well as the radial clearances are about 2 inches., nevertheless, the steam consumptions obtained with the Zoelly turbine is claimed to be lower than that of any other make, particularly for the large size high speed units. It is what can best be called a commerial machine, that is a machine giving, with the greatest reliability, best economy and least wear, with a minimum of attendance required. The total thermodynamical efficiency obtained has been as high as 74 per cent.

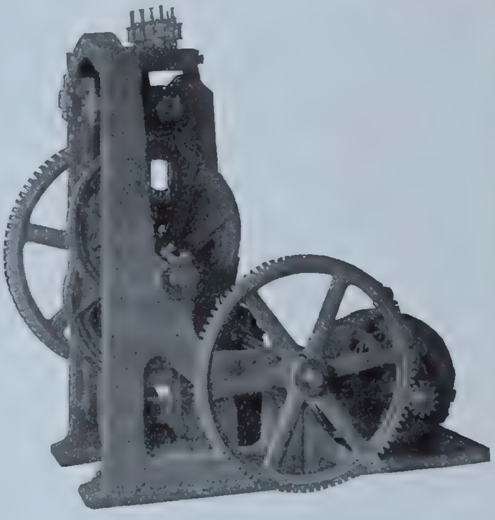
Twenty firms are at present licencees of the Escher Wyss Co., of Zurich, who built the first machines and have since supplied the bulk of those put on the market.

Up to 1913, Zoelly turbines of 3,350,000 horse power have been supplied by the Zoelly Syndicate, of which those built by Escher Wyss & Co., had a capacity of over 800,000 horse power. The largest size machine was 15,000 k.w., equal to 28,000 horse power. Two of these units were supplied to the Rheinisch-Westfaelisches Elektrizitaetswerk (Germany)—one in 1911, and the second as a repeat order in 1913. A number of machines of similar size have been built for other concerns, a plant of four 10,000 k.w. units for the Chile Exploration Co., of New York, being a pertinent example.

A NON-PULSATING PUMP.

INTEREST in the pump shown in the illustration lies in the fact that the pistons are not operated from a crank shaft, as in the ordinary type of reciprocating pump, but by cams. The cams are keyed to the main shaft and each transmits its motion to its piston by means of a sliding yoke, rollers being used to minimize friction between the cam and the yoke.

The manufacturers claim that this construction keeps the load on the piston uniform instead of passing through a cycle running from full load to a complete stop and back again, as in the crank shaft pump. Hence there is no pulsation, less strain on the pump, and high efficiency owing to the absence of backlash when gears and other parts become worn. In fact the manufacturers guarantee an efficiency of 80 per cent. for the pump, which is higher than can be obtained from the ordinary crank shaft pump.



A NON-PULSATING PUMP.

The Luitweiler Pumping Engine Co., Cleveland, Ohio, are the manufacturers, while Westinghouse Electric Co. motors are used for the drive.

Catalogues

Air Compressors. — The Canadian Ingersoll Rand Co., Montreal, Que., are distributing a leaflet calling attention to the "individuality" of Ingersoll Rand Compressors, and touching on a few claims made in this respect.

Motor Generator Sets.—The Lincoln Electric Co., Cleveland, Ohio, have issued a bulletin descriptive of the "Lincoln" motor generator sets for automobile battery charging and other transforming purposes. Full particulars are given of these sets with illustrations, showing their general arrangement.

Starting Switches, self-acting type for a.c. motors are dealt with at length in pamphlet No. 611, recently issued by the Igranic Electric Co., Ltd., London, England. Several applications of the "Igranic" starting switches for push button, remote, pressure or float control are described and accompanied by illustrations.

The Elliott Company, Pittsburgh, Pa., have published Bulletin No. 89, which has as its subject "How to Take Oil Out of Boiler Feed Water." The bulletin deals with the "Elliott" grease extractors applied to pumping stations, and covers the subject in a comprehensive manner. An illustration is included showing the "Elliott" twin filter and grease extractor.

Air Compressors and Vacuum Pumps.—The Mesta Machine Co., Pittsburgh, Pa., have sent us a copy of Bulletin N., devoted to a description of the air compressors and vacuum pumps which they make. The bulletin contains a description of the principal features embodied in the design of the above equipment. Included with the illustrations are reproductions of indicator cards and a volumetric efficiency diagram.

"Renewo" Valves are the subject of an attractive little booklet just issued by the Lunkenheimer Co., Cincinnati, Ohio. The principal feature of these valves, viz., the removable seat, is explained clearly in the reading matter and also by means of sectional views of the valve showing the constructional features. The illustrations are colored and embrace views of a complete set of repair parts. A price list is, included, of repair parts for various sizes of valves.

Balanced Draft System.—Bulletin No. 12, entitled "Documents in Evidence," issued by the Engineer Company, New York. The bulletin contains a number of testimonials giving opinions in regard to the balanced draft system of furnace regulation. The illustrations include views of a demonstration with and without balanced draft, several prominent buildings where the system is installed, and a sectional elevation of a boiler showing the application of the balanced draft system of furnace regulation.

Push Button Control "Safety First" devices for industrial plants, is the title of a bulletin being distributed by the Canadian General Electric Co., Ltd., Toronto. The bulletin deals with the application of the C.G.E. push button control for electric motors in factories as a means of increased production and as a safeguard against possible accidents. Illustrations are given of a number of machines in operation, showing the location of push button control in relation to the starting apparatus.

Valves and Hydrants. The Kerr Engine Co., Ltd., Walkerville, Ont., have sent us a new catalogue No. 5, dealing with the full line of valves and hydrants which they make. The various types are illustrated and include the most recent designs. The catalogue contains a full description of the majority of types

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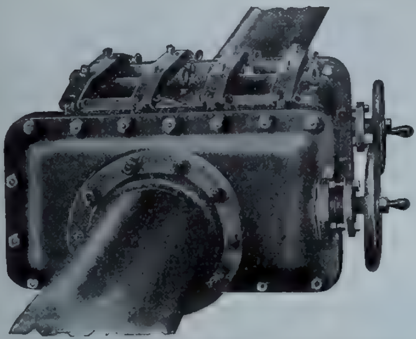
The only DIRECT FLOW Strainer built that gives continuous service.



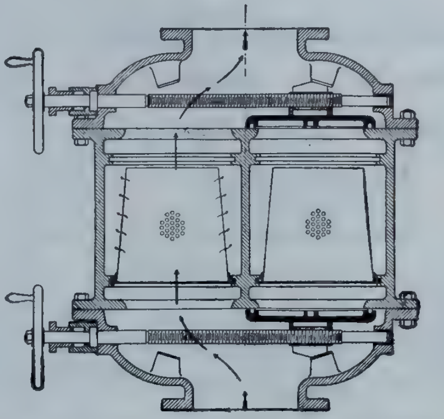
Horizontal position, doors on top.

Do your condenser tubes become clogged with rubbish?

Do your pump valves get stopped up, cut out, need constant attention?

Do you have trouble with any of your water handling machinery, on account of the leaves, sticks, grass, etc., in your service water?

The TWIN STRAINER is the best remedy for such troubles. The thousands of them in use to-day is the best evidence we have of their satisfactory service.



Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

An Expert's Opinion

The following is an extract from a letter recently written in answer to a request for expert information relating to boiler tube cleaning:

"Your valued letter of the 4th received, enclosing letter from the Liberty Company, manufacturers of Turbine Tube Cleaners. I have carefully read their letter, and I congratulate you on having gone to a party who is conservative, and the longest in the business of any manufacturer of mechanical Tube Cleaners for water tube boilers."

This letter was written by the head of a Company who are recognized as authority in all matters pertaining to the constructing and operating of all types of steam boilers. We obtained the letter from a correspondent, and are not at liberty to use their name. When such men recognize the superiority of **Liberty Cleaners**, you are certainly taking **no risk** in allowing us to send you one of our Cleaners on trial.

Write for additional information, and free trial offer.

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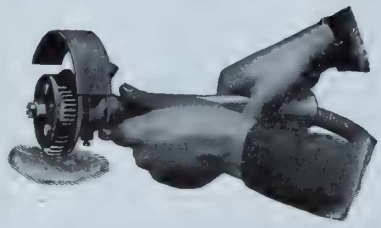
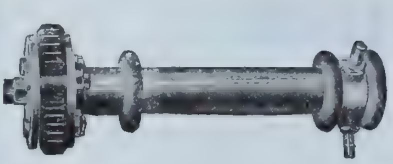


For boilers with large water spaces of all kinds.
For the removing of Rust and so on.
For sharpening of millstones.



For water tube boilers of all kinds, economizers, apparatuses vacuum, and so on.

Well adapted for small and large, straight and bent tubes.

Original Construction repeatedly improved.
Beware of inferior imitations.
PATENT DEVOORDE

For three years introduced with great success at home and abroad, and under most difficult proportions of scale brilliantly turned out.

Bader & Halbig,
Halle a. d. Saale (Germany)

together with price lists, while in some cases section views are given showing the constructional features. Other matter includes tables of flange dimensions and template drilling, telegraph code, etc. An index completes a very attractive catalogue.

Internal Furnace Boilers With Morrison Corrugated Furnaces is the title of booklet No. 4, of the Ryerson Technical Library, published by Joseph T. Ryerson & Son, Chicago, Ill. This is the eighth edition, and it is published with a view to describing in a brief manner some of the principal features of the "Continental" boiler, the description being supplemented by a few illustrations of boiler installations to show the adaptability of this type for stationary purposes. The booklet contains a description of the boiler furnace and process of manufacture. The illustrations include views of installations, accompanied by testimonials from the owners of the various plants. A list of users is also incorporated.

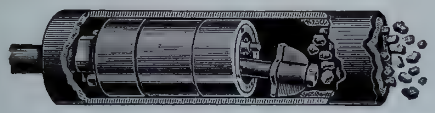
Detachable Link-belt.—The Link-Belt Co., Philadelphia, Pa., recently issued advance section (A) of general catalogue No. 110, dealing with the original Ewart detachable link-belt chains and sprocket wheels. This is a very complete catalogue, covering fully the well-known Ewart link-belt chains, attachments and sprocket wheels. The catalogue is fully illustrated, each item being numbered to correspond with the tables which give the price and other information for each type of chain, and also of the various attachments. Some interesting data is included on how to obtain the working strains and horse powers of link-belt chains, while the ultimate strength is given for each standard and special size instead of the working load as in former catalogues. Link-belt drives are discussed at length, accompanied by diagrams showing the action of chains under varying conditions. The section devoted to sprocket wheels includes several tables giving the price and other data for all sizes. This is a very useful catalogue for those interested in transmission machinery.

Columbia Recording Thermometers, is the title of a catalogue just issued by the Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y., and every operator if he wants to be up to the minute on recording thermometer construction should obtain a copy. It is unusually comprehensive, telling in an interesting way the mission of the recording thermometer in the modern industrial field, its great value to the engineer in helping him to obtain a maximum amount of power from a minimum coal consumption by enabling him to keep strict tab on boiler feed water temperatures, flue gas temperatures, etc. The catalogue is profusely illustrated showing numerous types. Many features outlined will be found to be departures in recording thermometer construction, the removable, adjustable and compensated recording pen arm being an improvement of much value. It makes chart changing easy and eliminates the possibility of errors due to temperature changes at the recorder case. The new patented fume and moisture proof insulation for the steel connecting tubing is worthy of note. It is a thoroughly insulated tubing, practically indestructible and yet flexible. The "Day and Night" border chart which is winning so much popularity commands its share of interest.

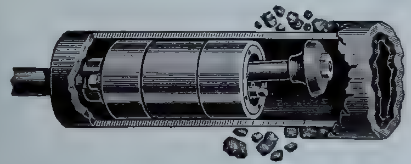
Book Reviews

The Knack of Selling.—The System Magazine, Wabash avenue and Madison avenue, Chicago, have issued a set of booklets on salesmanship, under the title "The Knack of Selling." These summarize in an attractive and informing way some of the best principles of salesmanship. The titles are "Mapping out the Canvass," "Managing the Interview," "How and When to Close," "Finding and Correcting Your Weak Points," "Getting In to See a Prospect," "Acquiring the Art of Mixing." The books are written in an attractive and readable style, while numerous illustrations from the experience of successful salesmen increase the value of the set. To many salesmen some of the individual suggestions will be easily worth the cost of the whole set of books, which sells for $5.

"**Steam Pipes,** their construction and arrangement," is the title of a handy volume published by the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England. The price of this book is only 25c., but it contains a lot of valuable information on steam pipes, prepared for Mr. C. Bullock, the chief engineer, by one of the company's assistant engineers. The text is based almost entirely on the actual experience of the company's engineering staff and should therefore be of special value to engineers in charge of steam plants; containing as it does, information obtained from exceptionally reliable authorities whose work brings them in touch with all phases of boiler and piping installations. The book contains 12 chapters, five of which deal with steam pipes and joints. Three of the chapters are devoted to such subjects as the velocity of steam and drainage of pipes, temperature changes and radiation losses, and pipe coverings, while the other chapters treat on equipment such as water separators, steam traps, and valves. The concluding chapters are devoted to a recapitulation covering the subject in a general manner. The volume contains 62 illustrations covering principally fittings and piping layouts. This book is



The Dean removing scale from the tube of a water-tube boiler.



The Dean removing scale from the tube of a return-tubular boiler.

FREE!

Are you interested in boiler cleaning?
Here's a **free** booklet—"Scale Removal Made Easy"—that you ought to have.
It was the means of saving one concern $50.00 a month.
Get a copy and see how much there is in it about scale that you never knew.
And you might **ask** about that wonderful result-producer—the Dean—at the same time.

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A fair trial of these splendid grease-and-graphite mixtures will convince you of their superiority over any grease alone. The graphite builds up a friction-reducing veneer on the metal that minimizes wear and that absolutely prevents a hot, binding bearing. There are six degrees of hardness in this line, covering every grease requirement. Send for a sample and Grease Booklet No. 222, stating the service you have in mind.

Made in Jersey City, N.J., by the

JOSEPH DIXON CRUCIBLE CO.

Established 1827.

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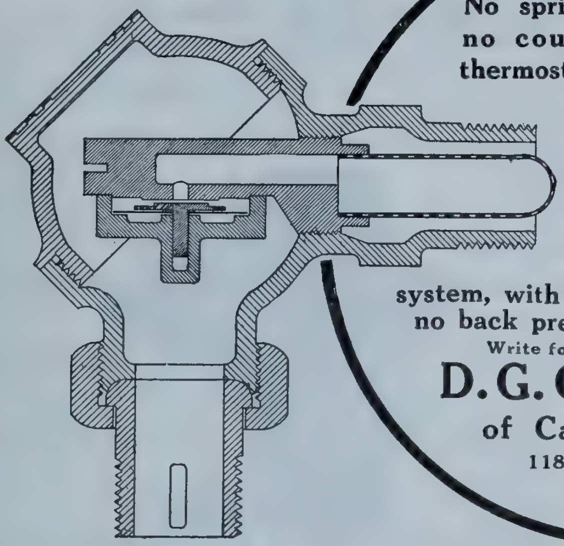

No springs, no floats, no counterweights, no thermostatic plugs, no regulating screws.

A simple and absolutely fool-proof valve that never gets out of adjustment, and which **guarantees a perfectly regulated heating system, with economy in steam and no back pressure on the engines.**

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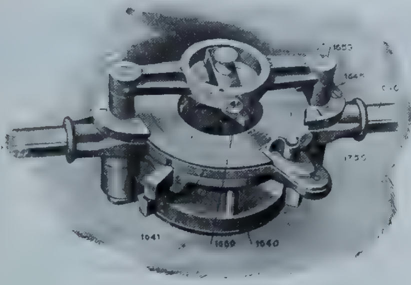
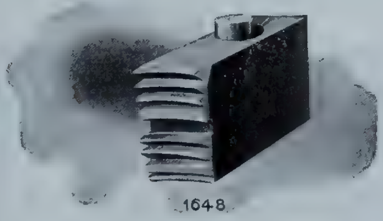
reaches—operating, superintending and consulting engineers in charge of steam, hydraulic and electrical power plants.



Die Stock Open



Two Dies in One

"Premier" Die Stocks

thread pipe 1 to 2 inches right, and 1 to 2 inches left with one set of dies.

It starts itself on the pipe and automatically throws itself out after a Briggs Standard Thread is cut, instead of backing off, which spoils the dies.

NO LEADER SCREWS OR NUTS

The **off-set die** enables you to accomplish, by going over pipe once, what any other make would do in going over twice.

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A want ad. in this paper will bring replies from all parts of Canada.

The advertiser would like to know where you saw his advertisement—tell him.

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There is always some one looking for just such proposition as you have to offer.

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250 K.V.A. Can. Westinghouse Generator, A.C. 2,200 volts, 60-cycle, three-phase, 257 R.P.M.

150 HP. Gas Engine, speed 275 R.P.M., manufactured by Bruce MacBeth, Cleveland.

Both machines are new, being installed six months ago.

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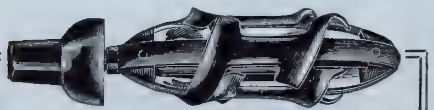

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Patent 1911

Has cutting edges of chisel shearing shape on both ends, which shave flue as clean as day it was made. Adjustable to wear—easily sharpened—strongly built. Made to do the work.
The IDEAL is the most perfect cleaner on the market to-day.
Sold on guarantee from your dealer or direct from manufacturer.

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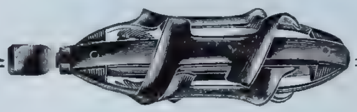

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acts on the iron—not on the water. It is a boiler treatment in a class by itself.
Water treatments are only partially successful, because the scale-forming sediment in water changes with seasons, climates and localities.
"MAGIC" removes scale and oil first, and then prevents scale forming. It stops pitting, corrosion and minor leaks.
"MAGIC" saves the boiler and much labor.

A trial will convince you—write us.

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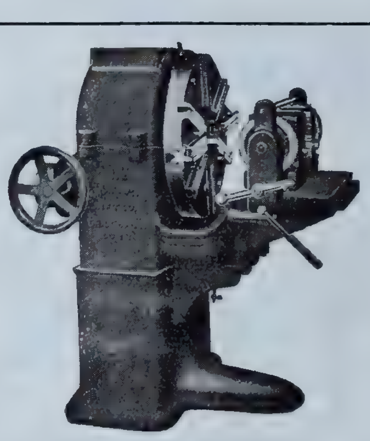

No. 3 PIPE MACHINE
THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES
A Very Desirable Machine for
PLUMBERS and STEAM FITTERS
Manufactured by
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Don't put off Renewing—Do it to-day
Neglect blew up the Boiler

one of a series of Vulcan engineering manuals.

Mechanical and Refrigerating Engineers' Handy-Book, by Otto Luhr, 900 pages 9 x 5¾; 312 illustrations, 109 tables. Published by Wahl-Henius Institute, Chicago, Ill. Price $5 net. This book has been written for handy reference, primarily for the refrigerating engineer, but at the same time to supply the needs of the mechanical engineer. The preface intimates that the information contained in the book had been collected from various sources, while a good deal of it is based on the author's own practical experience. The field covered is a wide one, and the subjects treated cover 900 pages, which must have entailed a considerable amount of work in the preparation of the book. The result, however, is an excellent work, written for the practical engineer, and containing an immense amount of valuable information which cannot help but be of the greatest assistance to the reader. The first chapters of the book deal with what might be termed the scientific aspect of engineering, treating on such subjects as physics, electricity, magnetism, chemistry and combustion. A description of various types of boilers follows, with chapters on steam and steam appliances, boiler water and its treatment. Steam engines, steam turbines and internal combustion engines occupy 96 pages of reading matter, dealing with the design of different types of prime movers and auxiliary equipment. The next chapter is devoted to the transmission of power, including such subjects as pulleys, belting, gearing, etc., followed by chapters on pumps and air compressors. The section of the book devoted to refrigeration comprises 209 pages and covers the subject in a more elaborate manner. One chapter on refrigeration includes such subjects as physical laws bearing on refrigeration, refrigerating machines, ammonia compressors and condensers, carbon dioxide and sulphur dioxide machines. The absorption system and brine system are next dealt with, followed by a chapter on insulation. The chapter on the application of refrigeration comprises 51 pages and covers ice-making, brewery refrigeration, cold storage, etc. The principles of electrical engineering are covered in 41 pages, and heating and ventilation in 15 pages. Other subjects treated are pipes, friction and lubricants, mensuration, and mathematical tables. The illustrations are numerous and where necessary, very complete, while the tables are well arranged and form a useful adjunct to the text. Among these are a steam table by Marks & Davis, and an ammonia table by H. I. McIntyre. A table of contents, index of subjects and list of tables complete a very useful volume.

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Stand in a Class by Themselves for Quality, Efficiency and Economy
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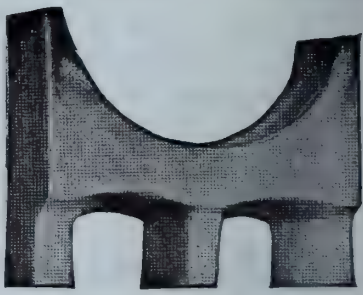

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Let us tell you how.

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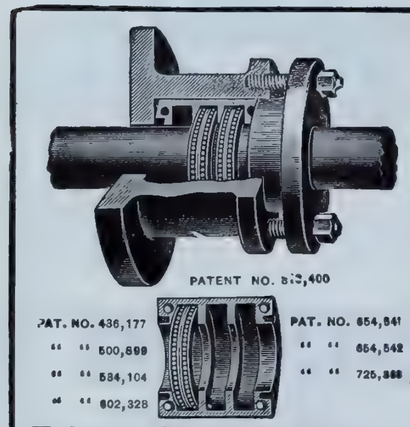

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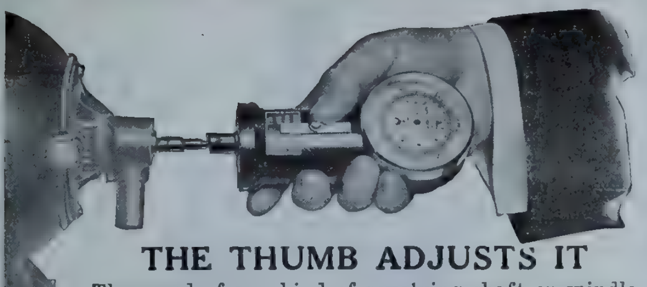

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Just read the speed on the dial. Write for Catalog.

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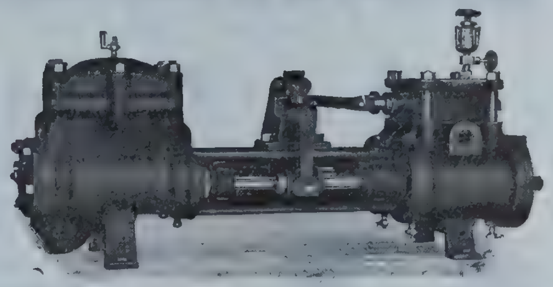

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POWER TRANSMISSION MACHINERY

assures highly satisfactory service because it is well made from high-grade materials by men of wide experience.

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have self-oiling bearings and when once filled with oil will run six months without re-filling.

The oil is drawn to the shaft by means of tempered steel rings and woven cotton wick. Easily lined up because of its adjustment in every direction.

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When GREASE
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This Grease Cup will pay for itself many times over with the money it saves in lubricants.

You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

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REMEMBER we guarantee it to save 50% over any other system.

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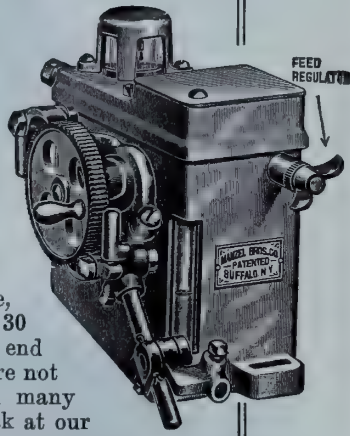

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You've nothing to lose by trying it—and much to gain.

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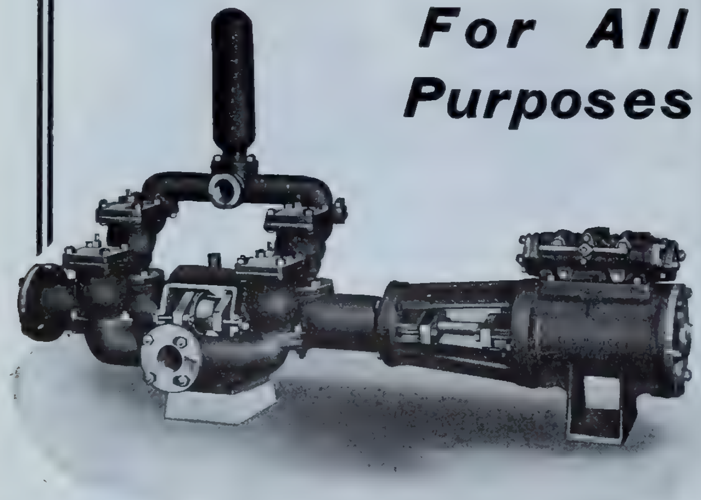

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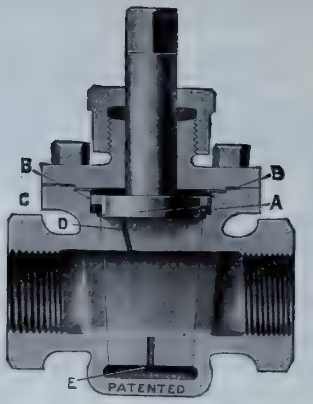

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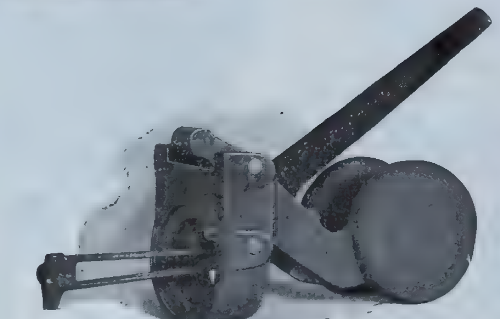

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Put the

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It automatically disposes of the condensation as fast as it accumulates, and adjusts itself to any varying amounts within its capacity.

To change from high to low pressure, or vice versa, all that is necessary is to change the valve and valve seat. This can be done in five minutes without disturbing or unscrewing a single joint or pipe connection.

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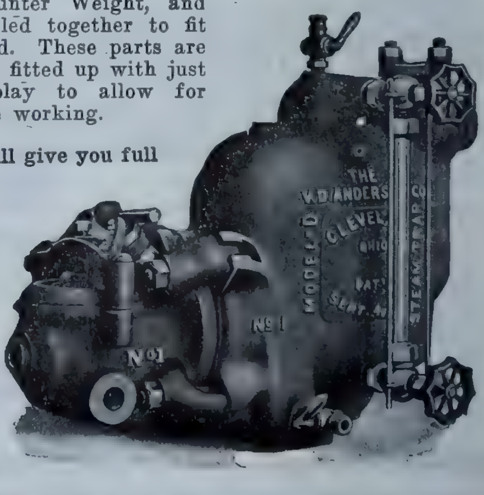

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The "Welo" Steam Trap, High and Low Pressure.
The "Welo" Vacuum Valves.
The "Welo" Temperature Regulators.
The "Welo" Hot Water Regulators.

These traps, valves and regulators are well known and widely sold in leading foreign countries, and their merits will quickly introduce them in Canada. *Sold under absolute guarantee.*

They work automatically under self-contained principle and will be fully described in subsequent issue of "The Power House."

Enterprising agents wanted throughout Canada.

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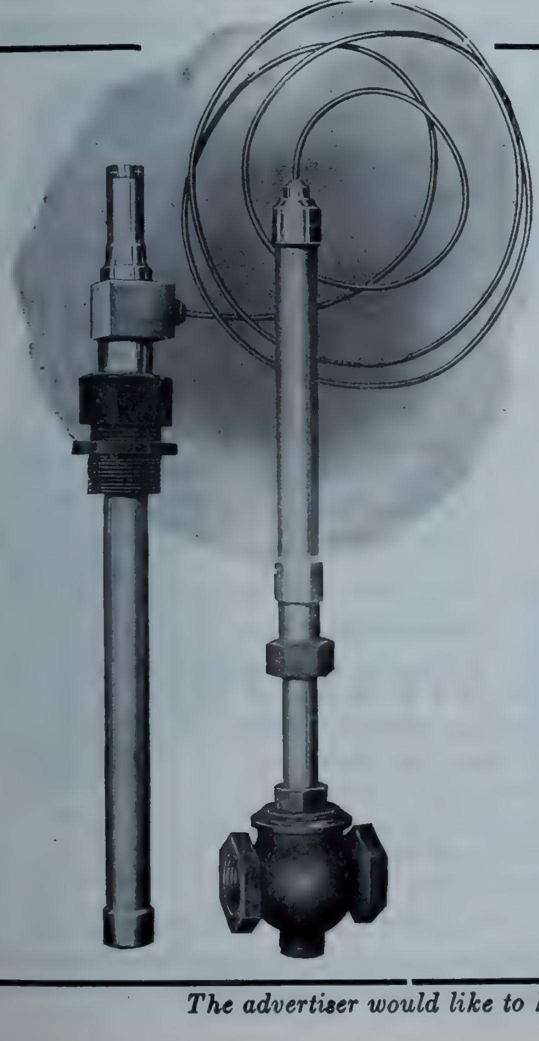

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in many delicate manufacturing processes. If such a process is involved in the making of your product, you realize how vitally important it is that your thermostatic regulator should be absolutely accurate.

"SARCO"

Water Temperature Regulators

Are Good Insurance

against such losses.

Sarco Regulators depend for their action upon a principle that is absolutely positive and unchanging. The action of the thermostatic element depends on the expansion of a sensitive liquid hermetically sealed within a chamber. Into this chamber is inserted a flexible corrugated tube connected with valve-operating mechanism controlling steam or hot water inlet, according to the temperature in the tank or room.

No leaky air-valves, perishable rubber or leather diaphragms, or variable metal disc diaphragms are used in the Sarco. Sarco-Regulators are exceedingly simple and cannot get out of order.

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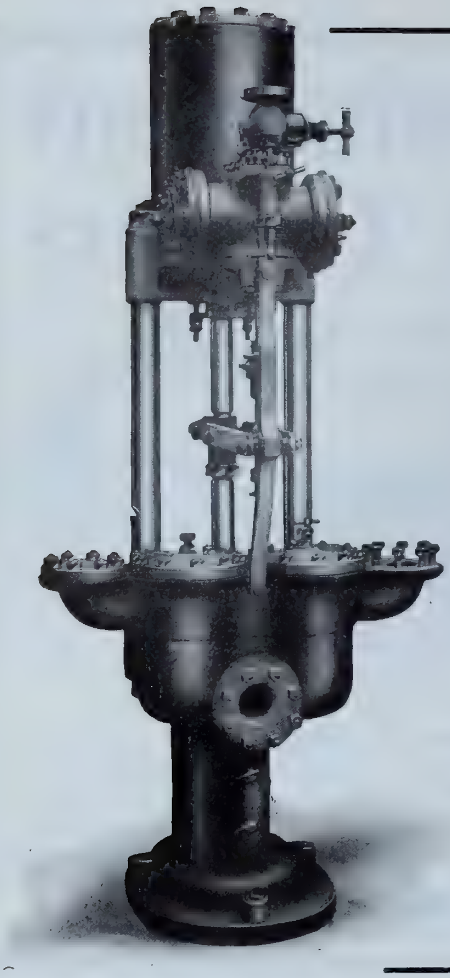

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The Largest Vessel in the World,
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Are all fitted with WEIR AUXILIARIES.

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For Every Service

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Marsh and American Pumps have a reputation for extreme simplicity combined with the highest efficiency. They are built for long continuous service and may be relied upon to do their work continuously, even under the most severe conditions. They cannot short-stroke, race or pound.

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Boiler Feed Pumps,	**Deep Well Engines,**
Vacuum Pumps,	**Air Compressors,**
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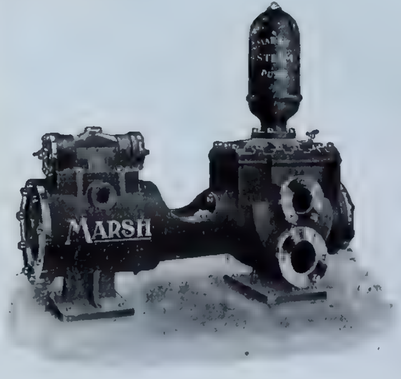

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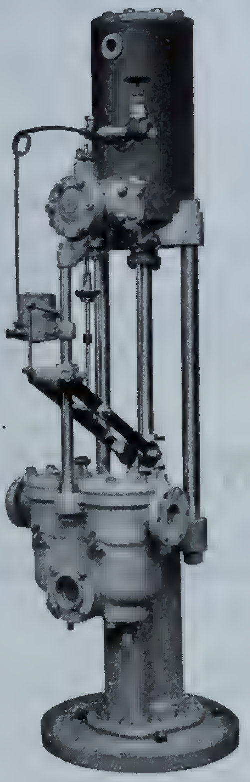

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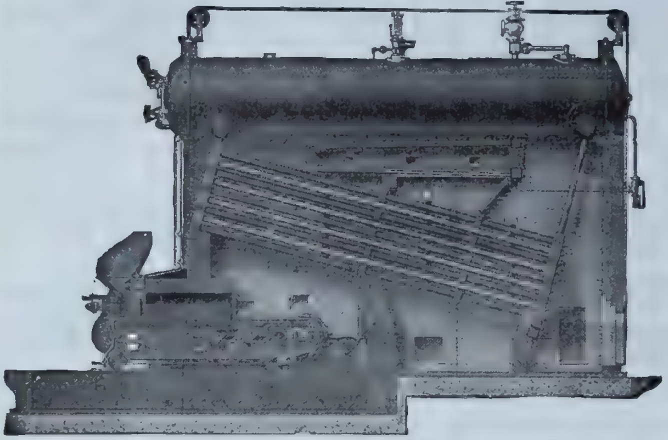

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Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

Engines, Automatic and Drop Valve.
Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
Goldie & McCulloch Co., Limited, Galt, Ont.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
John Inglis Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford,
Canadian Fairbanks-Morse Co., Ltd., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
W. H. Allen Son & Co., Bedford,
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Goldie & McCulloch Co., Limited, Galt, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks, Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Goldie & McCulloch Co., Limited, Galt, Ont.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.

Evaporators.
Canadian Griscom-Russell Co., Ltd., Montreal.

Exhaust Fans.
Griscom-Russell Co., New York.
W. H. Allen Son & Co. Bedford, Eng.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.
Griscom-Russell Co., New York.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Goldie & McCulloch Co., Limited, Galt, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Griscom-Russell Co., New York.

Filters.
Canadian Griscom-Russell Co., Ltd., Montreal.
John McDougall Caledonian Iron Wks, Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.,
Theodore Kipp Co., Winnipeg.

Fire Brick Masons.
Ideal Incinerator Co., Toronto.

Fire Extinguishers and Fire Alarm Apparatus.
Northern Electric Co., Ltd., Montreal.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick and Clay.
Betson Plastic Fire Brick Co., Rome, N.Y.
Ideal Incinerator Co., Toronto.

Fire Box Blocks.
Betson Plastic Fire Brick Co., Rome, N.Y.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
William B. Pierce Co., Buffalo, N.Y.

Flue Gas Analysis Instruments.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnaces.
John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert,

Furnace Linings and Arches.
Betson Plastic Fire Brick Co., Rome, N.Y.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.

Fuses, Renewable.
Economy Fuse & Mfg. Co. of Canada, Montreal.

Garbage Disposal.
Ideal Incinerator Co., Toronto.

Garbage Disposal Machinery.
C. O. Bartlett & Snow Co. of Canada, Montreal.

Gas Analysis Instruments, Etc.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gaskets, Rubber, Asbestos, Lead and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Durabla Mfg. Co., New York.
Frick Co., Waynesboro, Franklin Co.,
Goetze-Gasket & Packing Co., New Brunswick.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

Gas Producer Plants.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene & Oil Storage & Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
Durabla Mfg. Co., New York.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges, Ammonia, Oil, Gas, Air.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gears, Cut, Worm, Mortise.
Goldie & McCulloch Co., Limited, Galt, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Generators and Convertors.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Griscom-Russell Co., New York.
Siemens Co. of Canada, Ltd. Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.

Gongs.
Northern Electric Co., Ltd., Montreal.

Governors, Water Wheel
W. H. Allen Son & Co., Bedford, Eng.

Graphite, Boiler.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Governor, Water Wheel.
Can. Allis-Chalmers, Ltd., Toronto.

Graphitol.
C. C. Snowdon, Calgary.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Goldie & McCulloch Co., Limited, Galt, Ont.
Geo. H. Tod, Toronto.

Grease Cups.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.

Greases.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.

Gypsum Machinery.
C. O. Bartlett & Snow Co. of Canada, Montreal.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Heating Engineers.
Theodore Kipp Co., Winnipeg.

Hoists.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Schuchardt & Schutte, Toronto, Ont.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Inglis Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia,

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

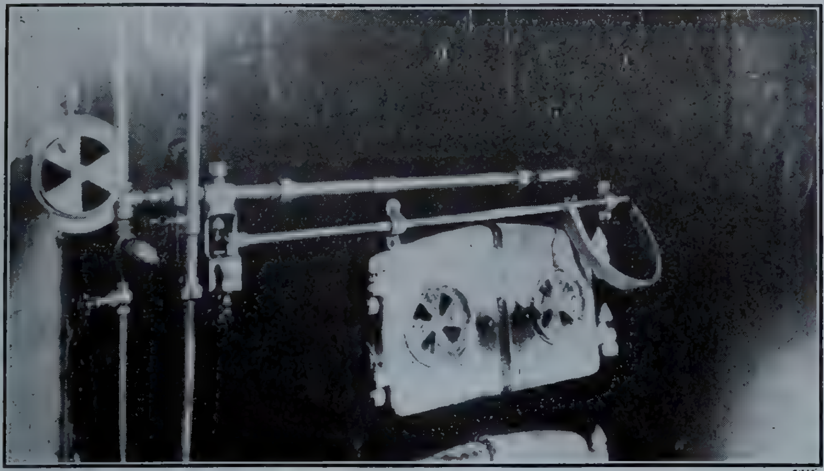
Hydraulic Machinery.
W. H. Allen Son & Co., Bedford, Eng.
John Inglis Co., Ltd., Toronto.
John McDougall Caledonian Iron Wks, Montreal.

Hydraulic Presses.
Bawden Machine Co., Toronto.

Ice Making Machinery.
Arctic Ice Machine Co. Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co.,
Linde British Refrigeration Co., Montreal.
John Inglis Co., Ltd., Toronto.
York Mfg. Co., York, Pa.

Insulators.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Geo. H. Tod, Toronto.
Northern Electric Co., Ltd., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.



GIBBONS-KEMP

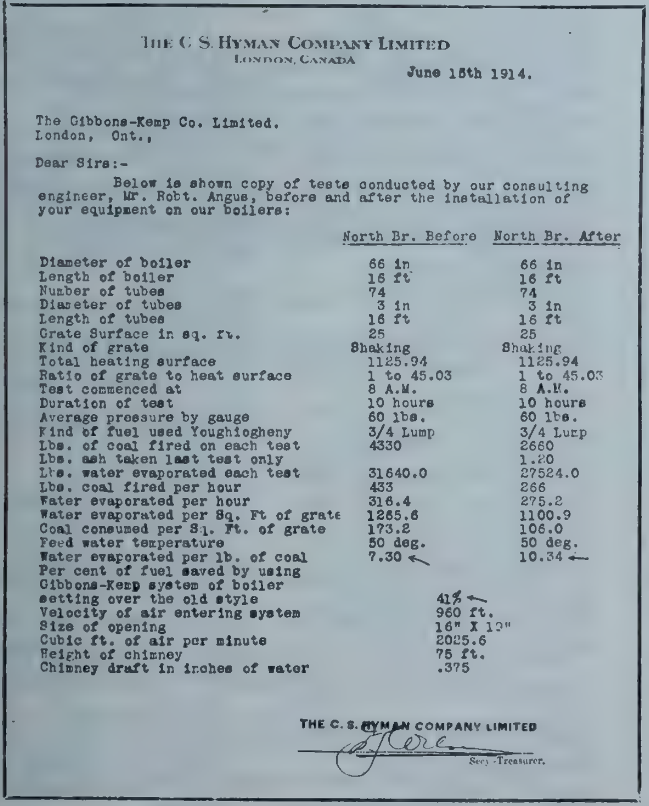
Oxygen Fuel System

Consists of a series of coned devices built into the side walls, bridge wall and front of boiler setting. The object is to mingle heated oxygen with the gases, when liberated from the fuel, and by so doing we get perfect combustion. A current of air is taken from the front of the boiler and passes along the coned side devices three times before it is delivered to the fire.

A current of air is also passed into a coned device placed within the bridge wall. Also a small steam jet, taking about one per cent. of the boiler capacity, is passed through the superheater, placed in front of the boiler setting, and is used only as a force for the purpose of mingling the oxygen with the carbon gases during firing.

An automatic valve, as shown in cut, is used to control the steam jet, which opens when the fire door is opened, and closes from thirty seconds to five minutes after the door is closed, and can be timed to suit the quality of coal used. Pre-heated air is used for draft, effecting the same economical results as the feeding of heated water in place of cold to the boiler. All heat used for pre-heating the oxygen and draft is waste heat, and therefore takes nothing from the efficiency of the boiler.

No force draft is used—the whole system being perfectly automatic, and although an intense heat is generated, it is distributed evenly over the full length of the boiler. No machinery is used in this installation, so there is nothing to get out of order to cause expensive repairs. The first cost is the only cost, and provided the fire lining is kept in repair, which has to be done in any case, our installation will last the life of the boiler.



THE C. S. HYMAN COMPANY LIMITED
LONDON, CANADA

June 15th 1914.

The Gibbons-Kemp Co. Limited.
London, Ont.,

Dear Sirs:-

Below is shown copy of tests conducted by our consulting engineer, Mr. Robt. Angus, before and after the installation of your equipment on our boilers:

	North Br. Before	North Br. After
Diameter of boiler	66 in	66 in
Length of boiler	16 ft	16 ft
Number of tubes	74	74
Diameter of tubes	3 in	3 in
Length of tubes	16 ft	16 ft
Grate Surface in sq. ft.	25	25
Kind of grate	Shaking	Shaking
Total heating surface	1125.94	1125.94
Ratio of grate to heat surface	1 to 45.03	1 to 45.03
Test commenced at	8 A.M.	8 A.M.
Duration of test	10 hours	10 hours
Average pressure by gauge	60 lbs.	60 lbs.
Kind of fuel used Youghiogheny	3/4 Lump	3/4 Lump
Lbs. of coal fired on each test	4330	2660
Lbs. ash taken last test only		1.20
Lbs. water evaporated each test	31640.0	27524.0
Lbs. coal fired per hour	433	266
Water evaporated per hour	316.4	275.2
Water evaporated per Sq. Ft of grate	1265.6	1100.9
Coal consumed per Sq. Ft. of grate	173.2	106.0
Feed water temperature	50 deg.	50 deg.
Water evaporated per lb. of coal	7.30 ←	10.34 ←
Per cent of fuel saved by using Gibbons-Kemp system of boiler setting over the old style	41% ←	
Velocity of air entering system	960 ft.	
Size of opening	16" X 12"	
Cubic ft. of air per minute	2025.6	
Height of chimney	75 ft.	
Chimney draft in inches of water	.375	

THE C. S. HYMAN COMPANY LIMITED

Sec'y-Treasurer.

This is the only system whereby you will get full 80% efficiency from your coal.

We guarantee a 15% saving in fuel, regardless of the quality of fuel, or whether it be coal, coke or wood, and guarantee to eliminate the smoke nuisance. If we do not produce these results we ask no pay.

Opposite is a reproduced report of an unbiased test made by C. S. Hyman Co., Limited, of London, Ont., after our installation was made.

Further particulars and list of other plants equipped, with copies of boiler tests, on request.

Gibbons-Kemp Co.

LIMITED

15 Greene Swift Building,
London, Ont.

Branch Office: 53 Yonge St., Toronto, Ont.

Incinerators.
Griscom-Russell Co., New York.
Ideal Incinerator Co., Toronto.
Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
Indicators—Ammonia, Hydraulic.
Detroit Lubricator Co., Walkerville.
Injectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Instruments.
Northern Electric Co., Ltd., Montreal.
Iron Filler.
Imperial Waste & Metal Co., Montreal.
Journal Greases.
Commercial Oil Co., Hamilton.
Lace Leathers.
Graton & Knight Mfg. Co., Montreal.
Lamps, Tungsten, etc.
Can. British Eng. Co., Winnipeg.
Canadian General Electric Co., Ltd., Toronto.
Can. Sunbeam Lamp Co., Toronto.
Northern Electric Co., Ltd., Montreal.
Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric Co., Ltd., Montreal.
Lubricants.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.
Commercial Oil Co., Hamilton.
Lubricators, Force Feed.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.
Lubricators, Plain.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.
Magnetos.
Northern Electric Co., Ltd., Montreal.
Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.
Measuring Instruments.
Northern Electric Co., Ltd., Montreal.
Metal Spools.
American Pulley Co., Philadelphia.
Meters, Electric.
Can. British Eng. Co., Winnipeg.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.
Siemens Co. of Canada, Ltd. Montreal.
Meters, Water.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.
Mica.
Kent Brothers, Kingston, Ont.
Mill and Mining Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Jenckes Machine Co. Sherbrooke, Que
Goldie & McCulloch Co., Galt.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.
Molds, Rubber.
Bawden Machine Co., Toronto.
Motors.
W. H. Allen Son & Co., Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd. Montreal.
Motor Starters and Controllers.
W. H. Allen Son & Co., Bedford, Eng.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd. Montreal.
Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.
Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.
Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.
Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor.
Lunkenheimer Co., Cincinnati, O.
Oil Filters & Circulating Systems.
S. F. Bowser & Co., Inc., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Oil Heaters and Coolers.
Griscom-Russell Co., New York.
Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.
Oiling Systems.
S. F. Bowser & Co., Inc., Toronto.
Theodore Kipp Co., Winnipeg.
Lunkenheimer Co., Cincinnati, Ohio.
Oils, Lubricating.
Can. Oil Companies, Ltd., Toronto.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.
Packing Engine.
Can. H. W. Johns-Manville Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Quaker City Rubber Co., Philadelphia, Pa.
Packing, Hydraulic.
Greene, Tweede & Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Packing, Metallic.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.
Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont
Packing, Sheet.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Mansville Co., Toronto.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Greene Tweed & Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.
Packing, Leather.
Graton & Knight Mfg. Co., Worcester, Mass.
Patents.
Rowland Brittain, Vancouver, B.C.
Paint Machinery.
C. O. Bartlett & Snow Co. of Canada, Montreal.
Penstocks.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
Pillow Blocks
Can. Bond Hanger & Coupling Co., Alexandria
Elmira Machinery & Transmission Co., Elmira, Ont
Goldie & McCulloch Co., Limited, Galt, Ont.
Pipe Coils.
National Pipe Bending Co., New Haven, Conn.
York Mfg. Co., York, Pa.
Pipe Threading and Cutting Machines (Hand, Belt and Motor).
Oster Mfg. Co., Cleveland, O.
Pipe, Steel
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Pipe (Second-Hand).
Imperial Waste & Metal Co., Montreal.
Pipes, Water.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.
Piping and Fittings.
Frick Co., Waynesboro, Franklin Co., Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.
Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.
Plaster Mill Machinery.
C. O. Bartlett & Snow Co. of Canada, Montreal.
Plate Work.
Can. Allis-Chalmers, Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
Pneumatic Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Pliers.
Schuchardt & Schutte, Toronto, Ont.
Polish, Metal.
G. W. Hoffman, Indianapolis.
Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Power Transmission Machinery.
American Pulley Co., Philadelphia.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
Goldie & McCulloch Co., Limited, Galt, Ont.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.
Siemens Co. of Canada, Ltd. Montreal.
Presses.
John Inglis Co., Ltd., Toronto.
Pulleys.
American Pulley Co., Philadelphia.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira, Ont.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Works Co., Brantford.
Pulp Mill Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Pumping Machinery, Electrical.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
Pump Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Smart - Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.
Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.
Pumps, Air.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Contractors'.
W. H. Allen Son & Co., Bedford, Eng.
William Hamilton Co., Ltd., Peterborough.
Pumps, Hand and Power.
S. F. Bowser & Co., Inc., Toronto.
Pumps, Centrifugal.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Bromell Patents Co., Ltd., Glasgow, Scotland.
John Inglis Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks. Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
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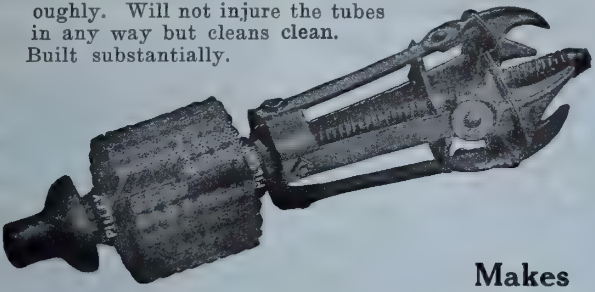

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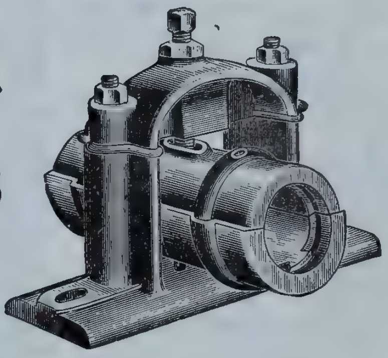

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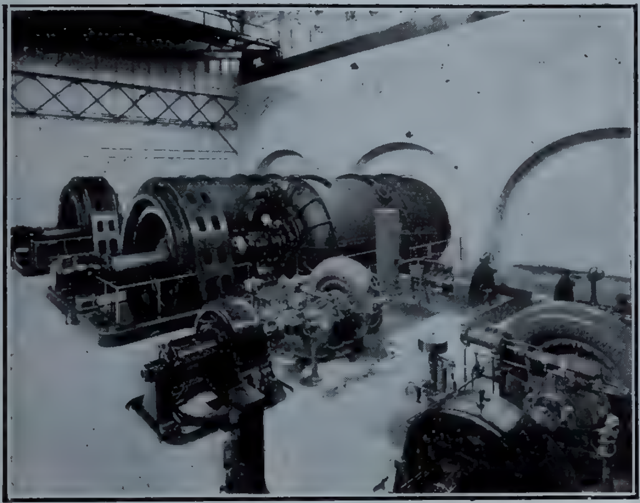

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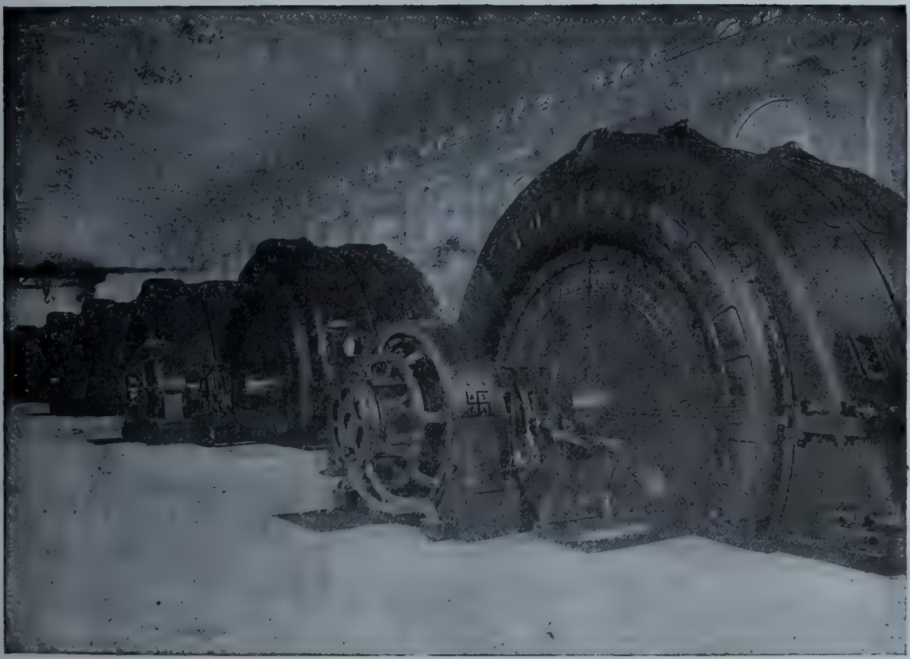

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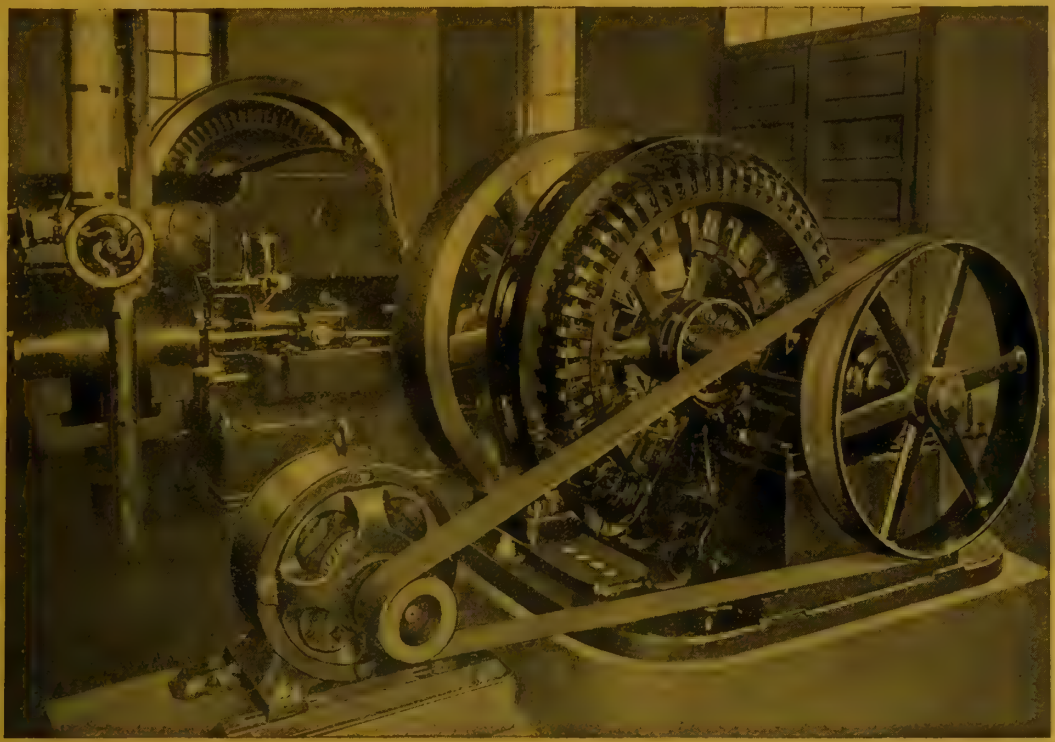


A Municipal Generating Station.
50 k.v.a. Westinghouse Type E Alternator, 2,200 Volts, 60 Cycle, 3 Phase.

Analyzing and Solving the Problem

THE smaller station's requirements demand the same careful study that is given larger power installations.

Westinghouse engineers investigated these requirements from the operator's standpoint, obtained their suggestions and then they designed a line of alternators to meet them. The result is the now well-known line of

Westinghouse Type E Alternators

They are designed for direct connection to gas, oil or steam engines or slow-speed water wheels. Tried out under these various methods of drive, they are heartily endorsed by several hundred well-satisfied users.

If you need a reliable, efficient generator for any of these services, investigate Westinghouse claims by writing our nearest office for descriptive matter and leaflet No. 2390.

Canadian Westinghouse Co., Ltd., Hamilton, Ontario

TORONTO
Traders Bank Bldg.

MONTREAL
52 Victoria Square

OTTAWA
Ahearn & Soper, Ltd.

HALIFAX
Telephone Bldg.

WINNIPEG
158 Portage Ave. E.

CALGARY
Grain Exchange Bldg.

VANCOUVER
Bank of Ottawa Bldg.

Recording Gauges

Sold with a

guarantee of TRADE MARK **J.M.T.** REGISTERED satisfaction.

James Morrison, Toronto

THERE is no uncertainty in the records kept by a good recording gauge. A glance at the day's record shows just how efficiently the firing in your boiler room has been done, every hour in the twenty-four. The recording gauge is the watchman that keeps tab on the boiler pressure always, that is never away, that never shirks, that is faithful unto the last—IF—the gauge is RIGHT.

Morrison Recording Gauges are the only gauges made in Canada, and we stake a clean business record of over thirty years on the long and faithful service that will be given by every gauge we make.

Gauges for Steam, Water, Air or Gas.

The James Morrison Brass Manufacturing Co., Limited
93-97 Adelaide Street West, TORONTO, CANADA

The advertiser would like to know where you saw his advertisement—tell him

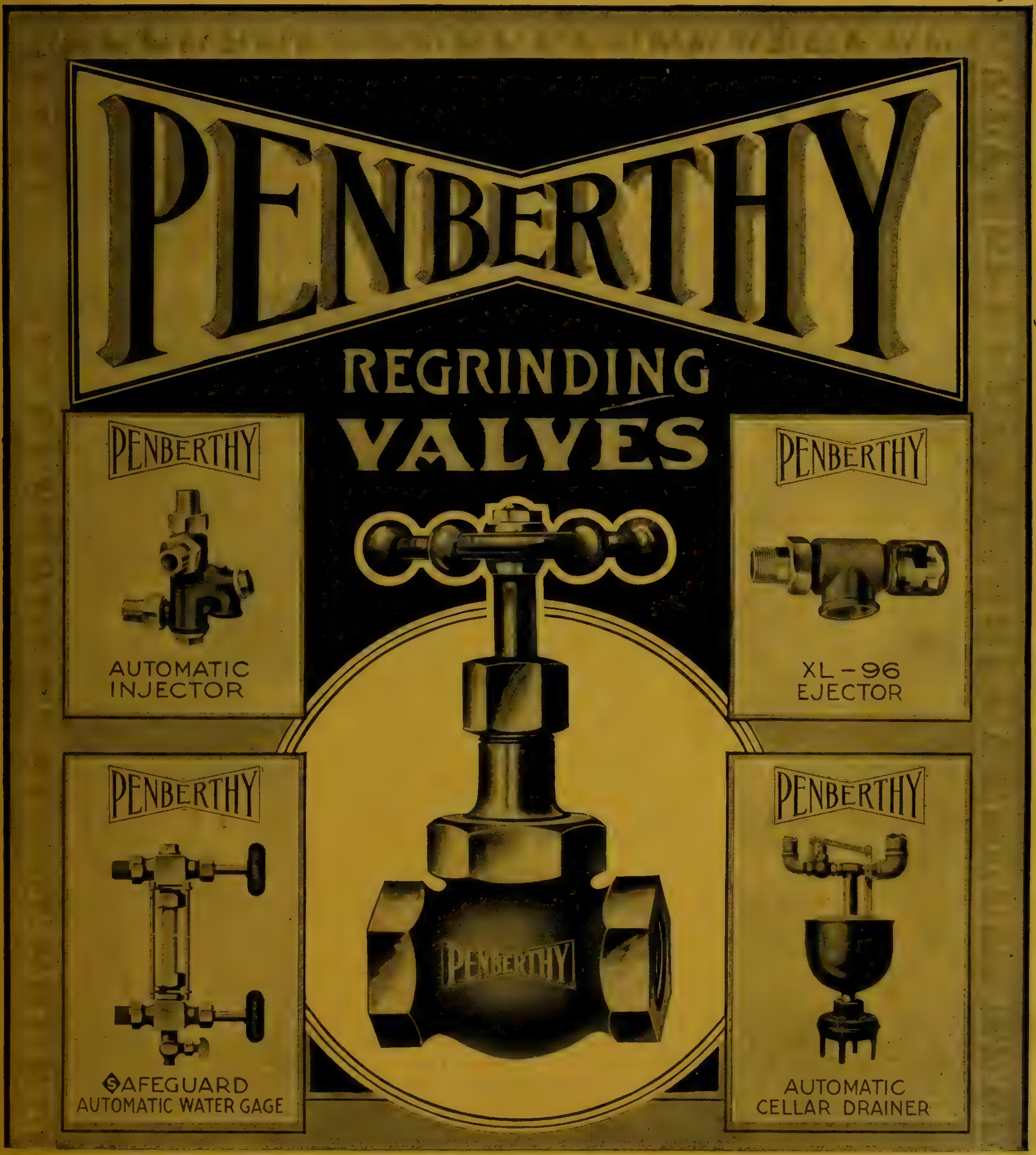
Special Feature—Report of C.A.S.E. Convention

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas
Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg.
TORONTO: 143-149 University Ave.
LONDON, ENG.: 88 Fleet St. E.C.
WINNIPEG: 34 Royal Bank Bldg.

Vol. VII | Publication Office Toronto—August, 1914 | No. 8



Manufactured by

Penberthy Injector Co., Limited, Windsor, Ont.

"INGLIS" BOILERS

For Any Service

Marine Boiler built for R. & O. Nav. Co. Str. "Rapids Prince"

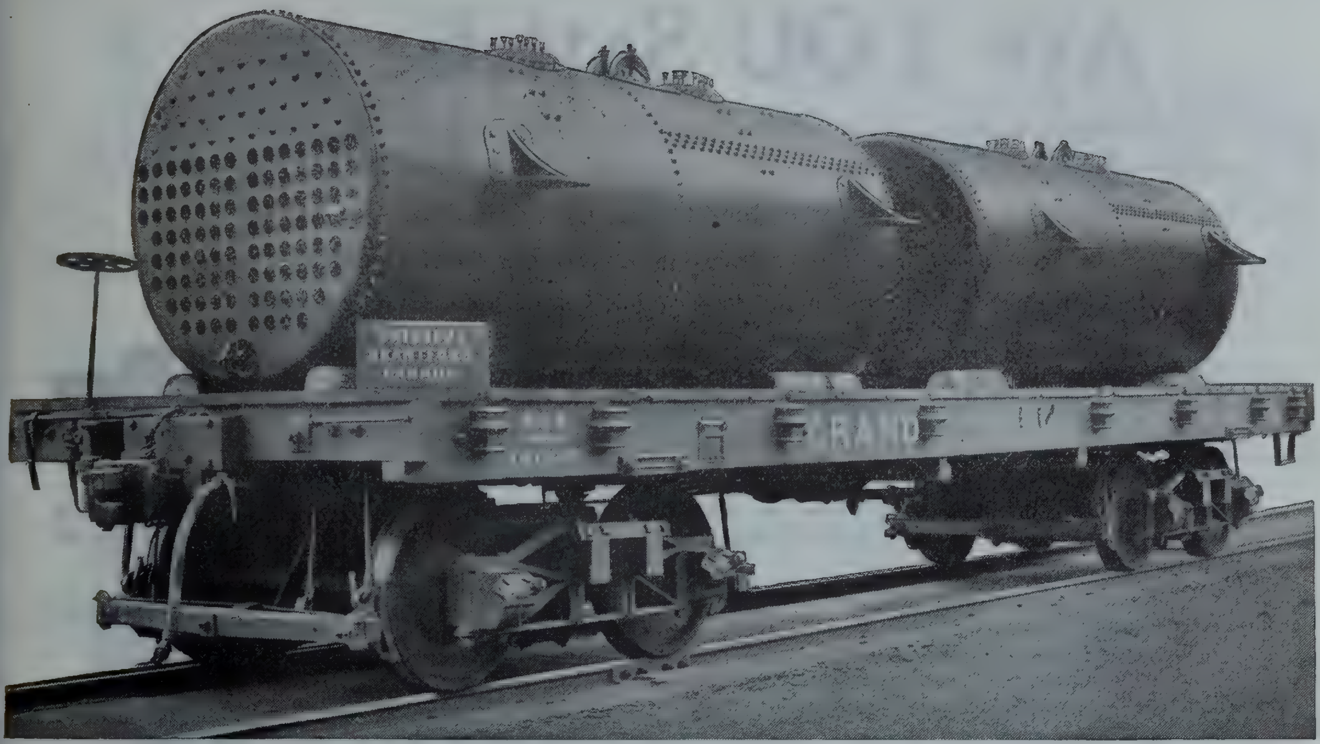
"Inglis" Boilers are the best. We make all kinds for any service. We are also Sole Canadian Manufacturers of the well-known Erie City Water Tube Boilers, Vertical and Horizontal.

WRITE US.

The John Inglis Company, Limited

ENGINEERS AND BOILERMAKERS

14 Strachan Ave., Toronto, Montreal Office, 509 Can. Express Bldg.



Economy In The Power Plant

Getting the full steam value from the fuel you burn is the *best* Boiler Room economy. Obtain it by using

WATEROUS
RETURN TUBULAR
BOILERS

Combined with the advantages possessed in general by this type of boiler—economy in fuel consumption, large steaming capacity, ability to use hard and dirty water, and comparatively low cost—we can furnish you with a boiler setting that is designed and dimensioned to best handle the fuel you use.

We build and carry in stock Return Tubular Boilers up to 72″ x 18′. If we cannot supply you at once from our yards we can turn out your order in quick time. **Let your next boiler be a Waterous.**

The Waterous Engine Works
Co., Limited
BRANTFORD CANADA

Are YOU Satisfied:--

That your heating plant gave you entire satisfaction during last season?

Did you have any freeze-up troubles?

Was the heating efficiency greatly reduced because of air binding?

Did your fuel consumption seem too large compared with the results of your system?

A DUNHAM SYSTEM is one way and many have found it the only way to eliminate all heating troubles.

A DUNHAM SYSTEM is designed to overcome these difficulties. IT has accomplished results for others. IT will make good with you.

It can be applied to your own heating system without much expense. A Dunham Radiator Trap applied to the return end of each radiator, a return system of piping to handle water of condensation and air, and a vacuum pump would constitute the equipment you would probably require.

Passes water and air freely. Closes off tight against steam. Does not clog up.

Now is the time for making changes in that Heating Plant of yours to eliminate troubles which will otherwise occur during the coming winter.

Do you want one of our traps to test out and prove their value to you? We want to consult with you as to the best method of improving your heating system.

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

MONTREAL—Room 20, 11 St. Sacrament St.
FORT WILLIAM—Plumbing & Engineering Supply Co.
HALIFAX—General Contractors Supply Co., Ltd., McCurdy Bldg.
VANCOUVER—520 Duncan Bldg.
CALGARY—Metals, Limited.
WINNIPEG—405 Tribune Bldg.

Made in Canada

Our Mixed Metal Sales Amount to Over $5,000,000 Annually

"FROST" KING Babbitt Metal

Proves its superiority at every test

It is especially designed for saw mills, planing mills, threshing machines, traction engines, pumps, rolling mills, and pulp machinery, and all classes of **stationary** engines.

You also find our "NICKEL GENUINE" exceptionally good for babbitting dynamos and motors.

If you cannot get these babbitts from your dealer, **we shall be pleased to make you a shipment of a twenty-five pound box.**

Hoyt Metal Co., Toronto, Ont.

New York, N.Y. London, Eng. St. Louis, Mo.

Jenckes Boilers

Heating Boilers

Vertical Tubular

Boilers for low, medium, and high pressures, of the various standard styles, and to pass any inspection.

Workmanship and materials are high grade in every respect, thoroughly inspected and tested.

Shipments, prompt and satisfactory, assured by a large number of finished boilers in stock as well as a variety of sizes in process of manufacture, which can be speedily completed for delivery.

Write for full particulars and references.

Locomotive Types

Horizontal Tubular

The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Toronto Cobalt
South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE., and ST. CATHARINES, ONT.

POTATO SCALE BOILER CLEANSER

Is a helper that's needed in your Boiler-room

It goes into the feed-water and destroys all scale-forming ingredients. It keeps the boiler clean and prevents pitting, corrosion, foaming and other boiler troubles due to impurities in the feed-water.

Its action is confined to the feed-water — it hasn't the power to cause the slightest injury to tubes or fittings.

It is made to suit feed-water conditions, and is **guaranteed** to produce satisfactory results.

Would you like to hear what users have to say? We will be pleased to put you in touch with some.

— —— —

C. C. SNOWDON

1810-1840 11th Street East, Calgary, Alberta. P.O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid-Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches:— Edmonton, Winnipeg, Vancouver

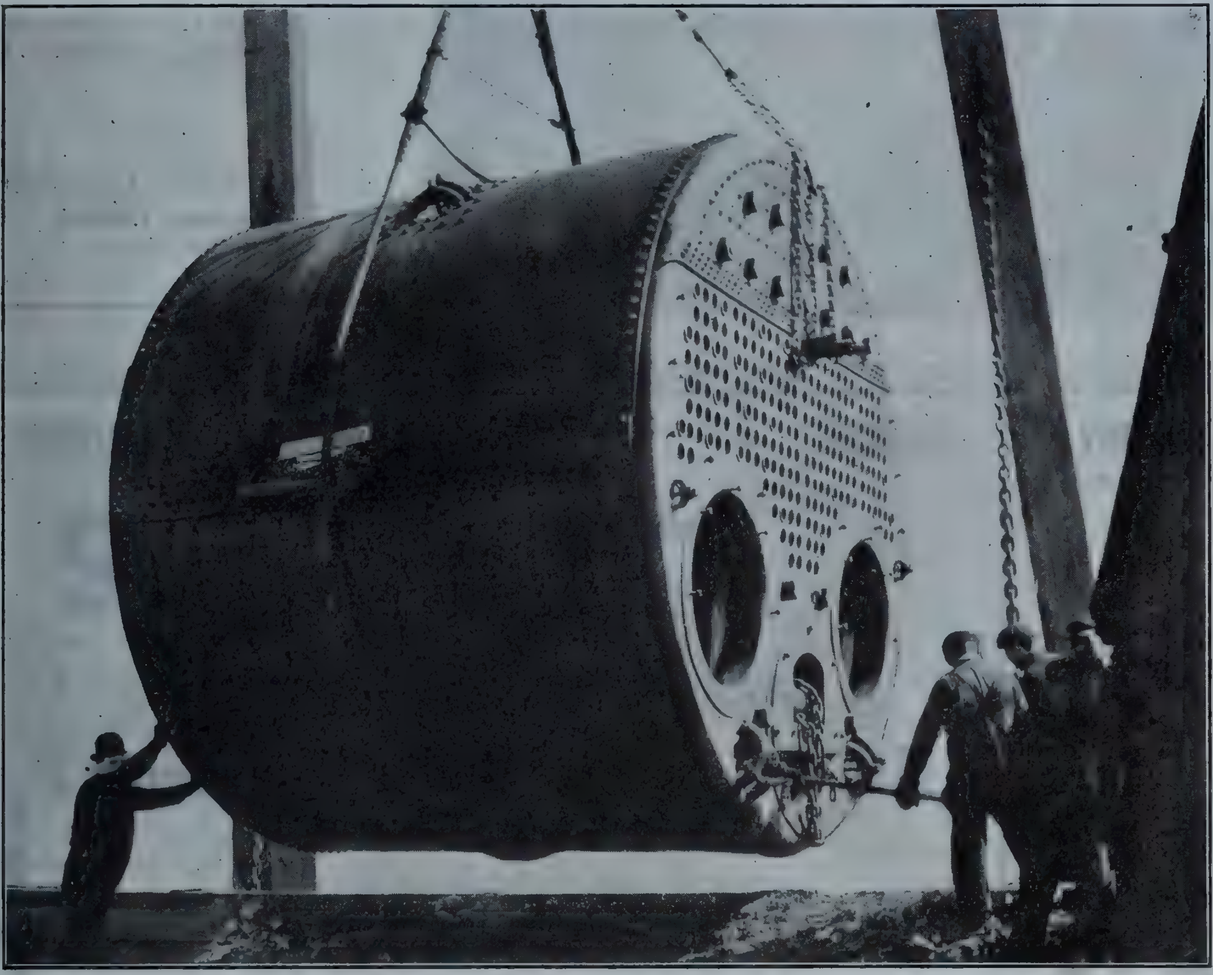
POLSON BOILERS

are built of best quality Flange Steel by skilled workmen.

The photo shows a Scotch Marine Boiler that has just been completed by us for the Steamer "Senator Derbyshire." 13′ 0 dia. x 11′ 0 long.

It is just another example of the popularity of Polson products, amongst engineers and men who know and appreciate good equipment.

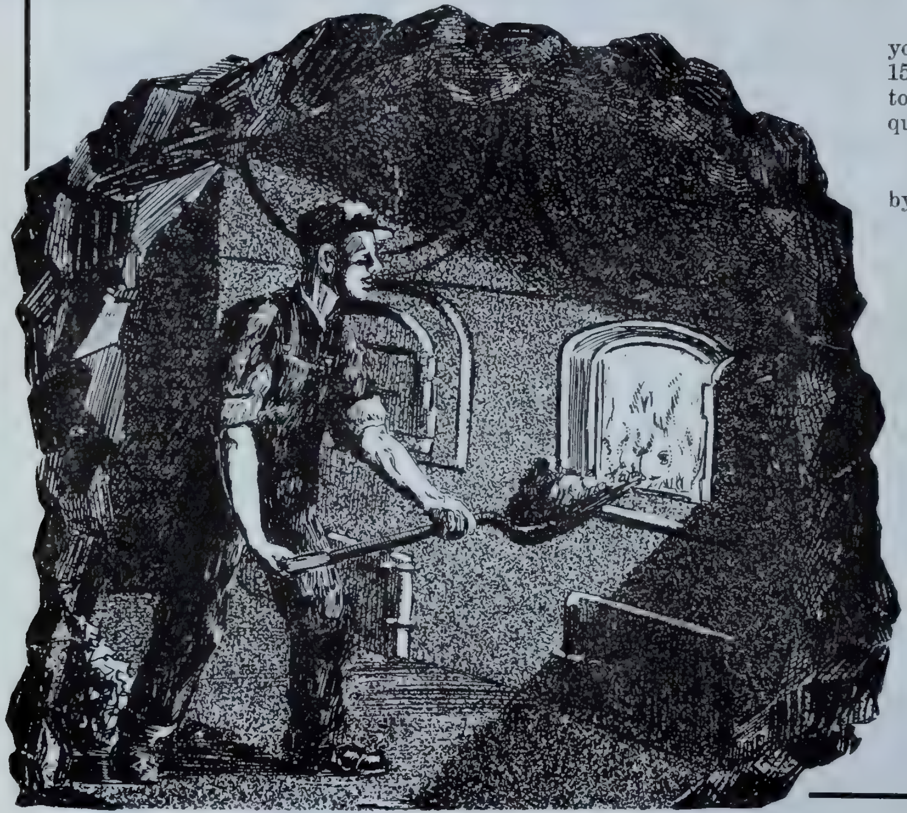
Put your plans and specifications up to us.



Polson Iron Works, Limited

Toronto, Ontario

Figure the Cost of fuel by the results



If there is even ⅛ of an inch of scale on your boiler tubes your fuel is costing you 15 to 25 per cent. more because it takes 15 to 25 per cent. more of it to produce required steam pressure.

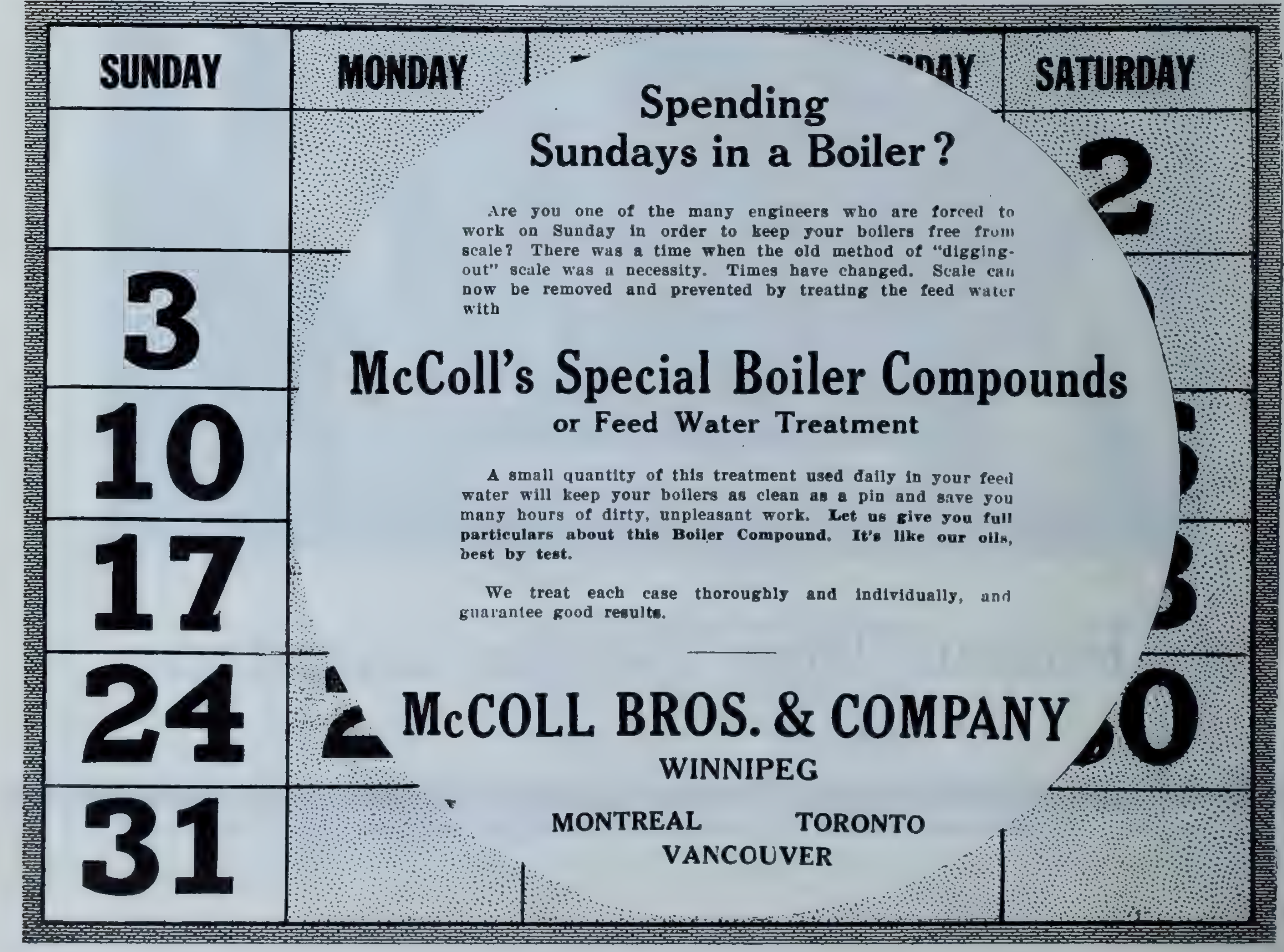
You can keep your bills at a minimum by simply using a small quantity of

Walker's Electric Boiler Compound

in your feed water. Use it continually. It will prevent pitting, corrosion, or other boiler troubles due to impurities in the feed water.

Guaranteed not to injure boiler fittings or pumps. Send for a barrel and be convinced.

The
Electric Boiler Compound
Company, Limited
Guelph, Ontario



Spending Sundays in a Boiler?

Are you one of the many engineers who are forced to work on Sunday in order to keep your boilers free from scale? There was a time when the old method of "digging-out" scale was a necessity. Times have changed. Scale can now be removed and prevented by treating the feed water with

McColl's Special Boiler Compounds

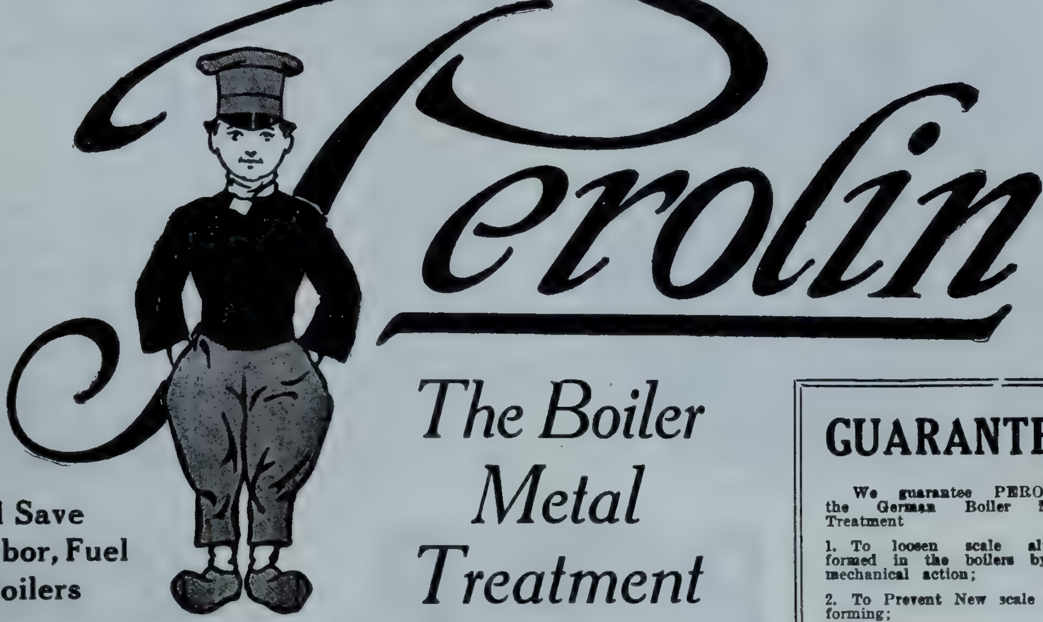
or Feed Water Treatment

A small quantity of this treatment used daily in your feed water will keep your boilers as clean as a pin and save you many hours of dirty, unpleasant work. **Let us give you full particulars about this Boiler Compound. It's like our oils, best by test.**

We treat each case thoroughly and individually, and guarantee good results.

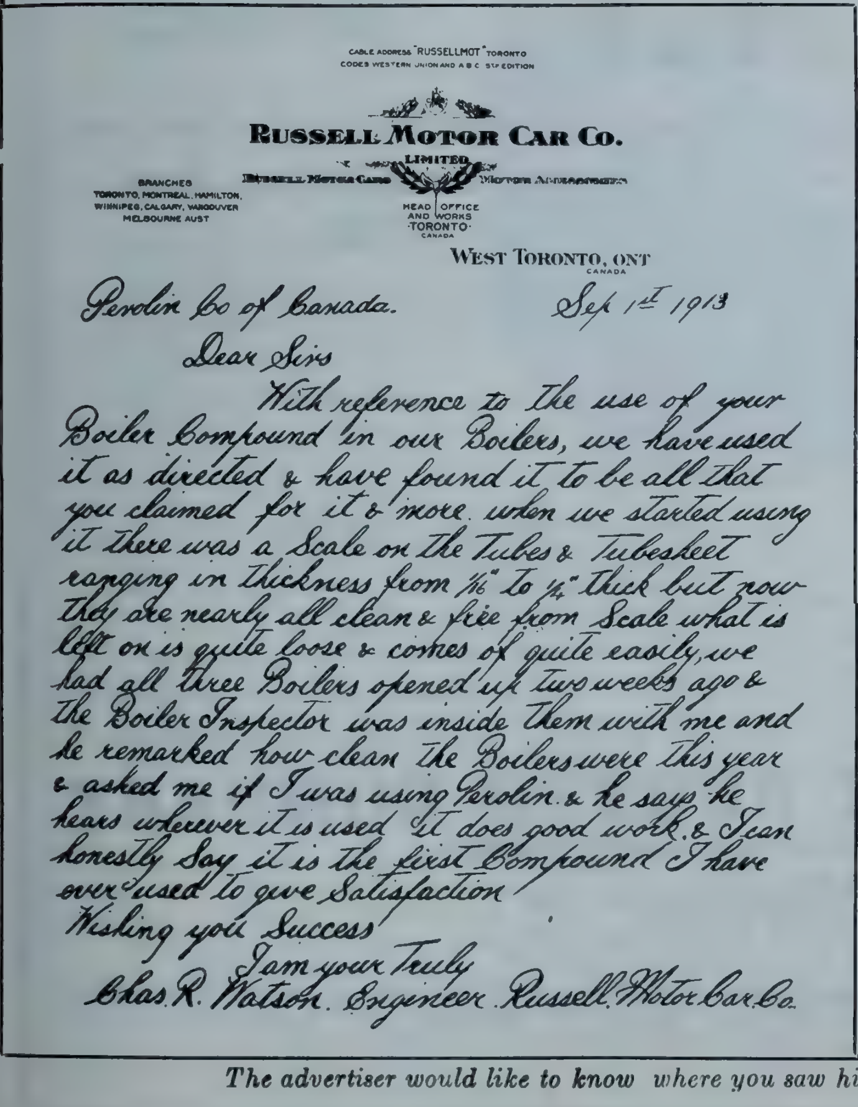
McCOLL BROS. & COMPANY
WINNIPEG
MONTREAL TORONTO
VANCOUVER

GET THE HABIT OF USING



The Boiler Metal Treatment

You'll Save Time, Labor, Fuel and Boilers



CABLE ADDRESS "RUSSELLMOT" TORONTO
CODES WESTERN UNION AND A B C 5TH EDITION

RUSSELL MOTOR CAR CO.
LIMITED
RUSSELL MOTOR CARS — MOTOR ACCESSORIES

BRANCHES
TORONTO, MONTREAL, HAMILTON,
WINNIPEG, CALGARY, VANCOUVER
MELBOURNE AUST

HEAD OFFICE AND WORKS
TORONTO
CANADA

WEST TORONTO, ONT
CANADA

Perolin Co of Canada. Sep 1st 1913

Dear Sirs

With reference to the use of your Boiler Compound in our Boilers, we have used it as directed & have found it to be all that you claimed for it & more. when we started using it there was a Scale on the Tubes & Tubesheet ranging in thickness from 1/16" To 1/4" thick but now they are nearly all clean & free from Scale what is left on is quite loose & comes of quite easily, we had all three Boilers opened up two weeks ago & the Boiler Inspector was inside them with me and he remarked how clean the Boilers were this year & asked me if I was using Perolin & he says he hears wherever it is used it does good work. & I can honestly Say it is the first Compound I have ever used to give Satisfaction

Wishing you Success

I am your Truly

Chas. R. Watson. Engineer. Russell Motor Car Co.

GUARANTEE

We guarantee PEROLIN, the German Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

Perolin is used by over 20,000 engineers throughout the United States and Canada. It's giving satisfaction everywhere. **If you'll write us, we'll demonstrate its merits in your plant at our own expense.**

Perolin Company

of Canada, Limited

76 Adelaide St. W., Toronto, Ont.

Quebec Agents: Burroughs, Joyce & Co., 30 St. John St., Montreal, P.Q.

Manitoba and Northern Ontario Agents: Engineering & General Supply Co., Ltd., 206 Nanton Building, Winnipeg, Man.

Agents for Alberta: The Western Supply & Equipment Co., Ltd., Calgary.

The advertiser would like to know where you saw his advertisement—tell him.

"How Different It Is Since I've Been Using P.P.P."

"It used to be that I spent most of my Sundays in the engine room, packing, packing, while you and the boy wasted many a bright day at home.

"Sunday never was a 'day of rest' until I tried a sample set of good, old P. P. P. Now, it's a weekly holiday for all three of us."

DANIEL'S ROD PACKING

P. P. P.

FOR STEAM, AIR, WATER, AMMONIA

This is the ORIGINAL and ONLY "diagonal" rod packing—the first made with "sliding wedges" and a "compressible cushion."

There are scientific reasons back of both the materials and the construction of Daniel's P. P. P.—the cheap materials and unscientific construction of imitations can never give the results of the GENUINE.

Tens of thousands of engineers throughout the United States, Canada, Central and South America, Europe and South Africa know and use none but "good, old P. P. P."

License Examination Book FREE

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name ....
Address ....
Employed by ....
Address ....
Horsepower of engine ....
Kind of Rod Packing used ....
Kind of Sheet Packing used ....
Name of Buyer ....
.. ..
....Series 24-H

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.
629 Market St.

We are the sole manufacturers of Daniel's P. P. P. Rod Packing, Daniel's EBONITE Sheet Packing, Daniel's Ebonite Steam Hose, IRONSIDES, and Hercules Rubber Belting, Daniel's Valve Grinders, QUAKER Tires—the "Miles Cheaper" kind.

Send for the Engineers' Catalogue of Mechanical Rubber Goods whether you are a large or a small buyer. It is a handy little book that will keep you posted.

Canadian Consolidated Rubber Co.

LIMITED

Executive Offices : Notre Dame Street, MONTREAL, P.Q.

Selling Agents for

Dominion Tire Co., Limited, Berlin, Ont.
The Canadian Rubber Co. of Montreal, Limited, Montreal, Que.
The Granby Rubber Co., Limited, Granby, P.Q.
The Merchants Rubber Co. Limited, Berlin, Ont.
The Berlin Rubber Manufacturing Co. Limited, Berlin, Ont.
The Maple Leaf Rubber Co. Limited, Port Dalhousie, Ont.
Dominion Rubber Co. Limited, St. Jerome, P.Q.
Berlin Felt Boot Co. Limited, Berlin, Ont.

RUBBER GOODS BEST BY TEST FOR ALL PURPOSES

Air Brake Hose (regular) and special "Non-freezing" Air Signal Hose.
Steam Heating Hose.
Vacuum Hose.
Hot Water Hose (White)
Cold Water Hose.
Air Hose—For Drills and Pneumatic Tools.
Hose Bags—Corrugated.
Heavy Suction Hose.
Wire-lined Gas Hose.
Fire Hose and Supplies.
Hose for every Special Use.

"Star" Red Sheet Packing.
"Canadian" Spiral Packing.
Pure Gum Sheet.
Valves—For Hot and Cold Water (All densities for any pressure).
Pebbled (Dot) Rubber.
Moulded Mats.
Hammer Bumpers.
Air Brake Gaskets.
Special Moulded Goods for every Mechanical Use.
Tubing—all sizes.
Rubber Strips.

RUBBER BOOTS AND SHOES. "Jacques Cartier," "Merchants," "Dominion," "Anchor," Brands.

Fleet Foot Outing and Sporting Shoes.

Felt Boots and Specialties, "Berlin" Brand

Automobile Tires Truck Tires Carriage Tires

Original "Diamond" design Inlaid Rubber Tiling. Estimates and Samples cheerfully furnished. We specialize in Rubber Goods required by Steamboat and Electrical Car Companies.

Write for Catalogues and Prices.

BRANCHES :

Halifax St. John Quebec Montreal Granby Ottawa Toronto Hamilton Brantford London Berlin Port Dalhousie North Bay Winnipeg Calgary Edmonton Saskatoon Regina Vancouver Victoria

GARLOCK

"Holdtite" Style No. 899

The Packing made specially for Extreme Pressures and Temperatures.

"Holdtite" will hold superheated and high-pressure steam, hot gases, ammonia, acids, alkalies, hot oils and other fluids and gases that are death and destruction to other packings.

Will successfully stand a temperature of 1500 degrees Fahr., and has a tensile strength of 6,000 lbs. per square inch. **Does not harden in joints.**

We offer every engineer an opportunity to test our style No. 899, so as to determine for himself whether or not our claims for the durability and efficiency of this packing are justified.

SEND FOR A SAMPLE TO-DAY AND LITERATURE

The GARLOCK PACKING COMPANY

Hamilton, Ont.

Montreal **Toronto** **Winnipeg** **Calgary**

"Pioneers in the Packing Business and Specialists"

See us at the Ottawa Convention

Don't Be Cheated With An Imitation

You know what "Palmetto" Packing will do, then why take a chance of having trouble by accepting a "JUST-AS-GOOD?"

It only means your dealer makes a little more money at your expense and ours.

No brand is imitated unless it has a well-established reputation, the result of merit tested by time.

TRADE MARK

"PALMETTO" PACKING

REG. U.S PAT. OFFICE

has many imitators in looks only, never in long, satisfactory service, for which it has always been famous.

Examine Your Packing When You Receive It

and if it is not the genuine "Palmetto," having the red tin tag attached, **SEND IT BACK.**

The word "Palmetto" is your safeguard because we stand behind it and guarantee quality.

If you don't know the quality of "Palmetto" let us send you a free working sample.

GREENE, TWEED & CO., Sole Manufacturers **109 Duane St., New York**

Canadian Distributing Agents, The Canadian Fair-banks-Morse Co., Ltd., Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

CURED
OF A
"GENUINE" BAD HABIT

Saguenay Mills, Limited
Manufacturers and Dealers in
Pulpwood, Excelsior, Spoolwood, and all Kinds of Lumber
54 NOTRE DAME EAST

Montreal, March 3rd, 1914.

Gentlemen:

From 12 years' past experience the writer had not much faith in babbitt metal other than genuine babbitt. On taking charge of the above plant about three years ago, your Mr. Morrison induced me to give Magnolia Metal a trial. After much argument, I consented to do this on the understanding that Mr. Morrison choose the set of bearings under which the trial was to be made. We went through the plant together, and to my surprise the bearings of our large circular saw were selected. This saw runs at the rate of 2,500 r.p.m., and my assistant stated that in the past they were unable to keep babbitt in it more than **two months** at the outside. At the present time, after **three years**, the original Magnolia Metal bearing is still in the saw and appears to be **in good order** yet.

Since the above trial every bearing in our plant is babbitted with Magnolia Metal, and the mill is running in fine style, making ten hours per day every day in the year.

Yours truly,
SAGUENAY MILLS, LIMITED,
E. Healey, Superintendent.

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

Has a Specially Compounded Heat-Resisting Lining

The Steam Hose that Doesn't "Cook Itself to Death"

GOODYEAR
TORONTO
Steam Hose

This Goodyear Hose has a specially compounded rubber lining that prevents the steam from penetrating to the fabric. It is compounded so as to be unaffected by the heat.

It is this feature that gives the wonderful durability that is winning the preference for Goodyears wherever steam hose is bought on a **service** basis.

Comes either marline jacketed or steel wire wound.

The wire winding protects the hose from rough handling. Saves it when tools and other heavy objects are dropped upon it. Adds to the wearing quality when hose is dragged about.

Some prefer the marline jacketed for the comfort it affords when handled.

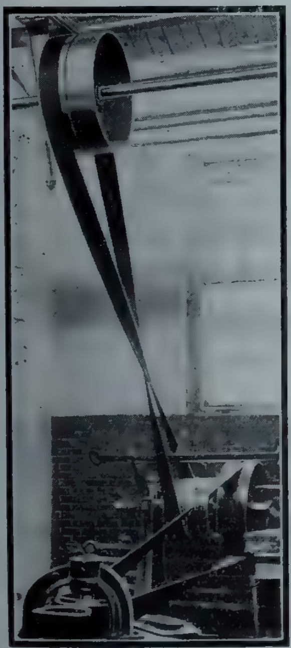
Both styles are made to resist oil and specially adapted for intermittent pressures. Won't elongate.

Hot Water Hose

For high and low temperatures. Goodyear construction throughout. Made for rough handling.

Every Goodyear Hose, whatever its purpose, is built to meet actual service conditions. No Goodyear product is ever made to meet a price. It is this Goodyear **service** idea which eventually saves you money and equipment.

Put your hose problems up to Goodyear experts. The Goodyear Efficiency Bureau is always at your service. Costs nothing to ask questions. No obligation involved.



Goodyear Belting

Whatever the belt need there is the very Goodyear Belt for it—designed and built for the specific purpose—general transmission—main drive—small pulley—conveyor belts—elevator belts, etc., etc.

Switchboard and Dynamo Mats

Either plain or corrugated. The rubber is so carefully compounded that every mat is an absolute insulator. That's a mighty important factor where safety is so vital.

Consult Goodyear Experts

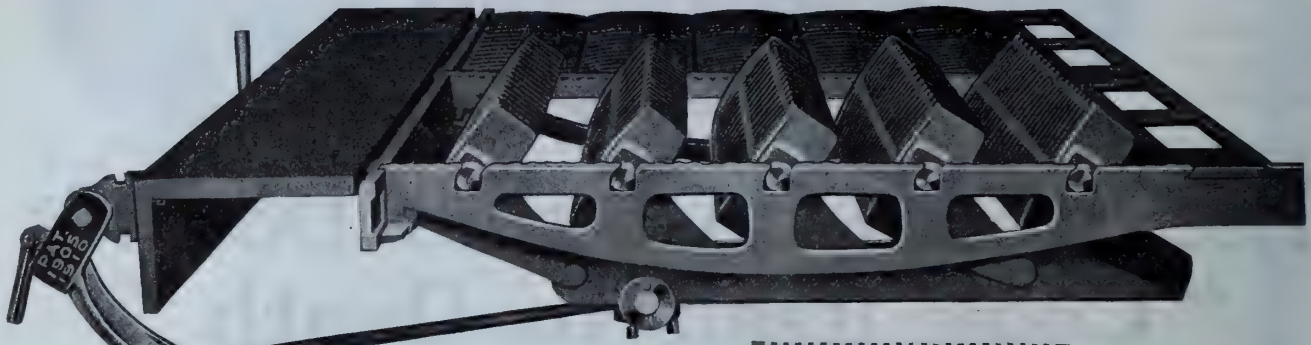
Consult the Goodyear Efficiency Bureau whenever you need belting, hose, packing or valves. If your problems are "different," that is exactly where Goodyear experts can help you. It costs nothing to consult these men. They will be glad to confer with you at any time. Their advice and counsel, cheerfully given, will save you many dollars. Buying the Goodyear way means buying once and for all.

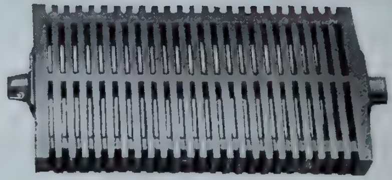
The Goodyear Tire & Rubber Co. of Canada, Limited

Head Office, Toronto, Ont. **Factory, Bowmanville, Ont.**

The "CYCLONE" Grate

makes cheaper steam





Shaking and Dumping

The 60% air space and 90% underdraught makes efficient combustion from the burning of hard or soft coal screenings, and assures an enormous saving in fuel.

The grates are kept free from ashes and clinkers by means of our **improved shaking mechanism,** which makes shaking more vigorous and effective, and doesn't allow any fuel to be wasted.

Because of their perfect balance Cyclone Grates are very easily operated.

The Cyclone locks level—it cannot get out of adjustment or become warped.

We are prepared to instal our grates in the plant of any bonafide company on 30 days' trial. They are easily and quickly installed; no shut down of plant or no expensive changes in brick work required.

If satisfactory, we will expect payment, as agreed on, and if not, we will remove the grate without cost or lost time to you.

The Cyclone is imitated in design, but unequalled in quality. Be sure to get the genuine, and you'll get the genuine good service.

Write for full particulars.

The Canadian Steam Boiler Equipment Co., Limited

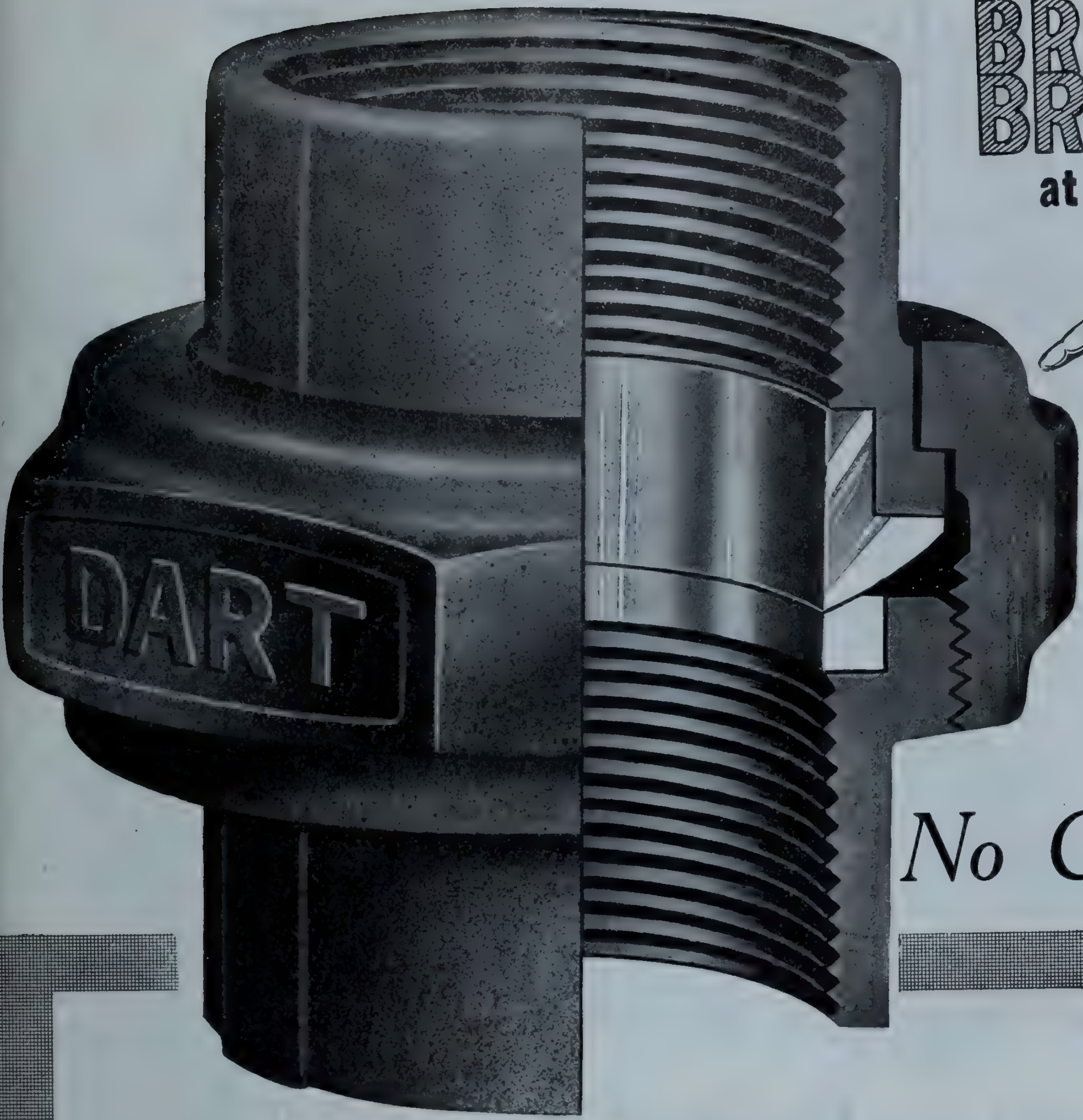
SOLE MANUFACTURERS FOR CANADA

20 McGEE ST. **Phone Gerrard 3660** **TORONTO, CANADA**

AGENTS:

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street. HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works. PORT ARTHUR, Northern Agency Co. C. Andrews, 390 King St., LONDON, Ont.

BRONZE TO BRONZE at the joint



No Corrosion

"Dart" Unions

have a bronze to bronze ball-shaped joint that does not deteriorate, and which allows a quickly and easily made connection, whether pipes are in or out of alignment.

As they never leak unless deliberately loosened with a wrench, there is no possibility of damage by drips.

Dart Unions have no maintenance cost, and do not have to be replaced.

They can be connected and disconnected time after time, and retain their efficiency.

Their heavy construction is proof against contraction, expansion, and vibration.

Your guarantee (our trade-mark) is cast on every "Dart." You'll promptly get two new ones if a "Dart" Union is defective.

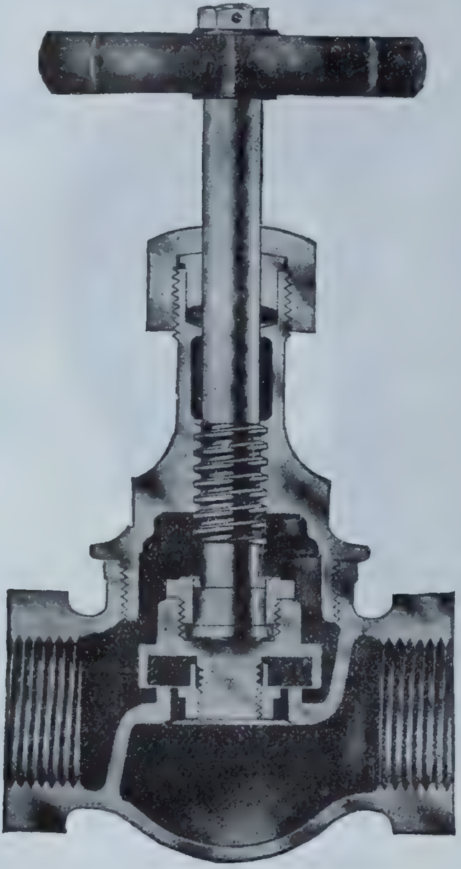
Your Jobber has them in all types

TRADE DART MARK

**Dart Union Co., Ltd.
Toronto**

The Valves that Stay Tight

Tightness under any working steam pressure up to 150 lbs. is assured without the necessity of any regrinding when you specify



Jenkins Bros.'

Brass Globe Valves

They represent a distinct type. In place of the usual metal clapper they contain a disc holder, made of brass or other suitable material and a removable Jenkins' Disc made of a softer material which readily adapts itself to the inequalities of the seat. The composition of the disc is varied to meet the exact requirements of the service for which the valves are intended.

These valves will stay tight indefinitely. When worn, a new disc may quickly be inserted by any one at a trifling cost, making the valve as good and tight as the first day that it was placed in the line.

Look for the Diamond and the Signature

Scrutinize every valve you buy. Be sure that you get only the GENUINE by looking for the DIAMOND and the signature "JENKINS BROS." underneath.

This trade-mark is plainly cast in the valve body for YOUR protection against the host of imitations with which the market is flooded.

For over 40 years JENKINS BROS.' Valves have made good. Forty years of constant study and manufacturing experience have kept Jenkins Bros.' Valves in the lead for Quality and SERVICE.

Your dealer can supply you in the sizes and quantities you want in either brass or iron body, globe, angle, cross, check or "Y" patterns.

Write us direct for full details.

JENKINS BROS., Limited

103 St. Remi Street **MONTREAL**

Pounds of Coal per H. P. per Hour

You must know how many lbs. of coal you burn each day in order that you may keep your power cost down to a minimum.

A Fairbanks Scale

will tell you quickly and accurately. The above illustration shows the application of a one-ton Fairbanks Suspension Coal Scale, with quick-weighing dial and mounted on a trolley.

Let us know the conditions in your power house and we will advise you as to the best method of handling your weighing problem.

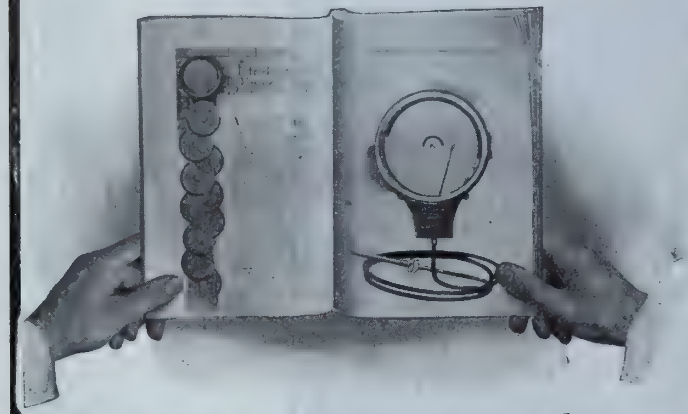
The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Quebec Ottawa Toronto Hamilton Ft. William
Saskatoon Calgary Edmonton Winnipeg Regina Vancouver Victoria

Canada's Departmental House for Mechanical Goods

The advertiser would like to know where you saw his advertisement—tell him.

A Catalog Well Worth Having



And It's Yours for the Asking

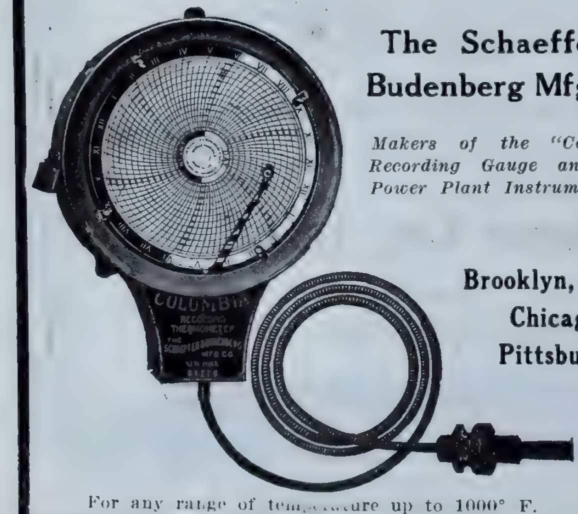
Don't you hesitate one minute, Mr. Engineer, in sending for a copy of this unusual catalog devoted to the "Columbia" Recording Thermometer — 42 pages "chuck full" of interesting and comprehensive data —telling of the mission of the Recording Thermometer —its great value in helping you to obtain a maximum amount of power from a minimum coal consumption by enabling you to keep strict tabs on boiler feed water temperatures, flue gas temperatures, etc.

The Catalog is profusely illustrated, showing the numerous types of

Columbia Recording Thermometers

—telling of the many new features which are absolute departures in Recording Thermometer construction. Telling why the "Columbia" has been recognized, by its undisputed superiority over contemporaries, of principle, design and construction, to be the LOGICAL Recording Thermometer for unfailing accuracy and dependable service in power plants and all industrial fields.

If you want to be "up to the minute" in Recording Thermometer construction, send a postal to-day for a copy of this valuable catalog. Just say: "Send me Catalog W 300."



The Schaeffer & Budenberg Mfg. Co.

Makers of the "Columbia" Recording Gauge and other Power Plant Instruments.

Brooklyn, N.Y.
Chicago,
Pittsburgh

For any range of temperature up to 1000° F.

Morehead
Back to Boiler
SYSTEM

60,000,000 Tons of Coal Thrown Away Yearly

Over 600,000,000 tons of coal are mined yearly in the United States and Canada. Ten per cent. of that enormous production is carelessly, needlessly wasted. Over Sixty Millions of Dollars are spent each year in producing—*nothing,* and yet, a mere fraction of that great loss, if properly applied, would save those wasted millions for years to come.

You are contributing to this national waste—but *you* can stop it.

Steam, after its expansive energy has been exhausted, is not *through* with its job. There are heat units left—live, tangible heat units which were purchased by coal at the boiler's mouth. What are you doing with these units? —this condensation, in other words?

With the Morehead System installed on your steam lines the condensation is automatically returned to the boiler—*without pumps—and at any temperature.* It is the last link from boiler back to boiler—the unused energy is *not* wasted.

If you would save this ten per cent. and have a clear steam system which drains automatically, write to-day for particulars.

Canadian Morehead Mfg. Co.
Limited
Department "J"
Woodstock, Ontario

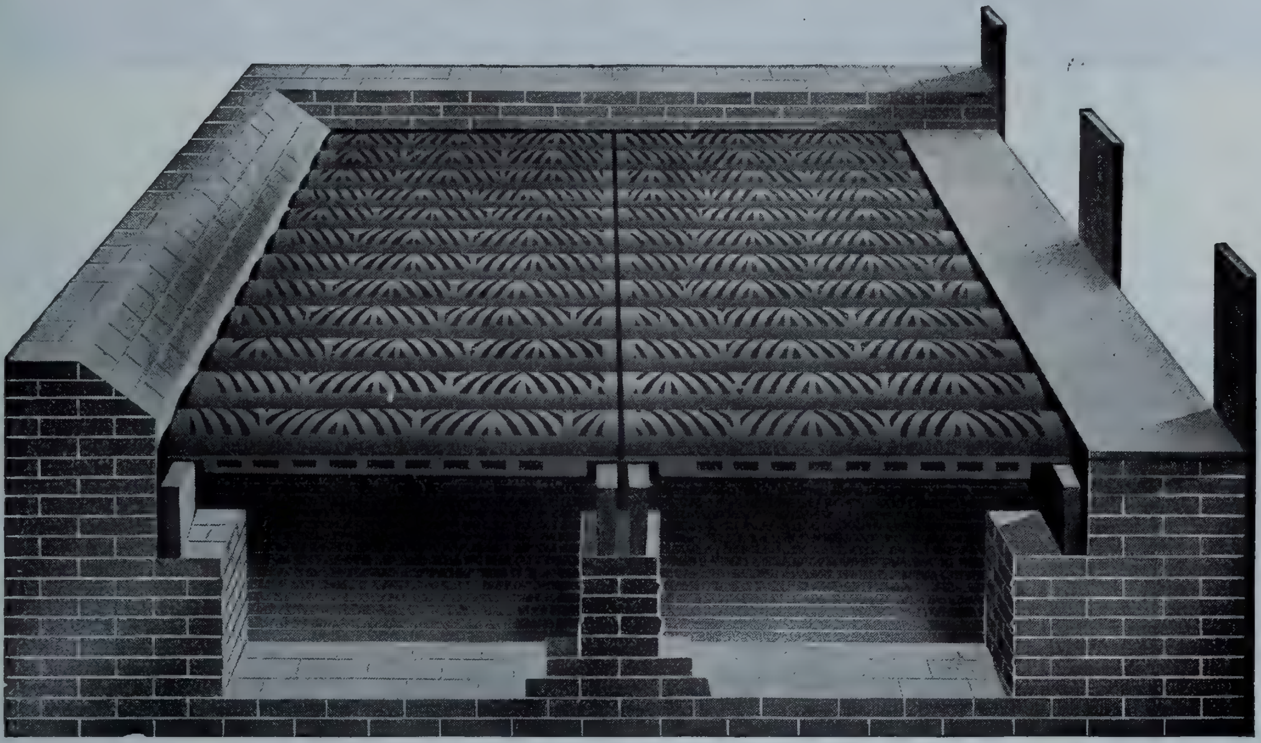
167

The advertiser would like to know where you saw his advertisement—tell him.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

G&K 1851
TRADE MARK

Educational Talks on Leather Belting.

Proper Installation of Belting

The proper installation of belting is just as fundamental to transmission efficiency as the proper selection of weight, quality and thickness. Maximum service may be obtained from belting by following certain general and long established rules.

First—Be sure pulleys are in line, and shafts parallel.

Probably more belting is ruined by improperly lined shafting and pulleys than by any other cause. Belts operating under such conditions are often kept on the pulleys by guides. They sometimes rub against hangers or portions of machines. As a result a lap starts open, the belt catches and tears. If no such accident happens, the belt usually stretches excessively on one edge. Belts so stretched will not run straight and are apt to run off the pulleys and become torn or otherwise damaged.

Test—If a belt climbs to one side of the pulleys look for trouble in the shafting. Turn the belt around, and if it still climbs to the same side of the pulley you have proved that the shafting is out of line.

Remember that because shafting was once in line it does not follow that it stays so indefinitely.

Second—Avoid putting on belts too tight.

When belts operate too tightly the leather is overstrained and injured. There is excessive friction at the bearings with a consequent loss of power. If belts run too loosely, they are likely to flop around and jump from the pulleys, especially where loads are intermittent or suddenly applied.

The slacker a belt can be run and transmit the required power without slipping, the greater the economy of the drive.

Third—Be sure that every belt runs in the proper direction.

Single belts should be put on so as to run with the grain or hair side next to the pulleys.

All belts should be put on so that the points of the laps on the outside of the belt point away from the direction in which the pulley is revolving.

Fourth—Exercise care when joining belting.

A cemented lap is not difficult to make, and is the most satisfactory method of joining a belt. It means increased life, smoother running, fewer repairs and therefore greater machine production. When a cemented lap is not practical, a laced joint is the next best method. But this joint must be made properly, extreme care being used to have all strands under equal tension, or a crooked belt will result. Always avoid the use of large lacing holes—they weaken the end of a belt; also avoid unnecessary bunches of lace—they cause slipping.

Fifth—Avoid water, oils, greases, etc.

Ordinary leather belting should not be used where any of these destructive elements are present, unless it is possible to protect the belting by mechanical means. But remember that G. & K. NEPTUNE Belting will withstand moisture and water, and is guaranteed not to open at the laps or between the plies even when wholly submerged. G. & K. SPARTAN Belting is guaranteed to resist the action of water, oil, acid fumes, and steam.

While we have offered above only a few general suggestions about the proper installation of belting, we wish to emphasize the importance of this point in securing an efficient drive. In the case of special drives, the details must be analyzed and the best belt secured. Our Engineering Department will gladly investigate any drive and recommend the proper belting and installation.

Our "Belting Manual," fresh from the press, contains ninety pages of useful mechanical rules and valuable information about belting, and its proper installation, selection, and care. A copy will be sent you gratis on request.

Subject for next month:—"The Care of Belting."

THE GRATON & KNIGHT MANUFACTURING CO.

Oak Leather Tanners and Belt Makers

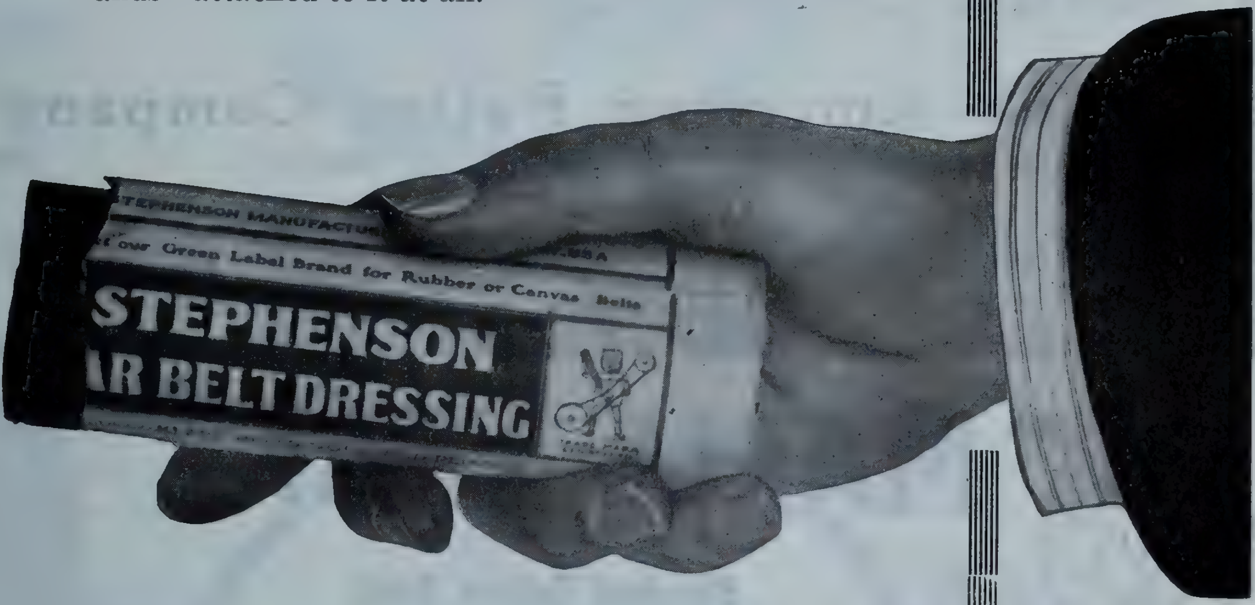
Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory: Worcester, Mass., U.S.A.

"Consult our Engineering Department in connection with your Transmission Problems"

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson
Manufacturing Co.
Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me **free of charge** a
half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....

THERE'S A REASON WHY

You Should Buy and Test

The "American"

You are not getting the best pulley value if you do not specify and insist that you receive "American" Pulleys.

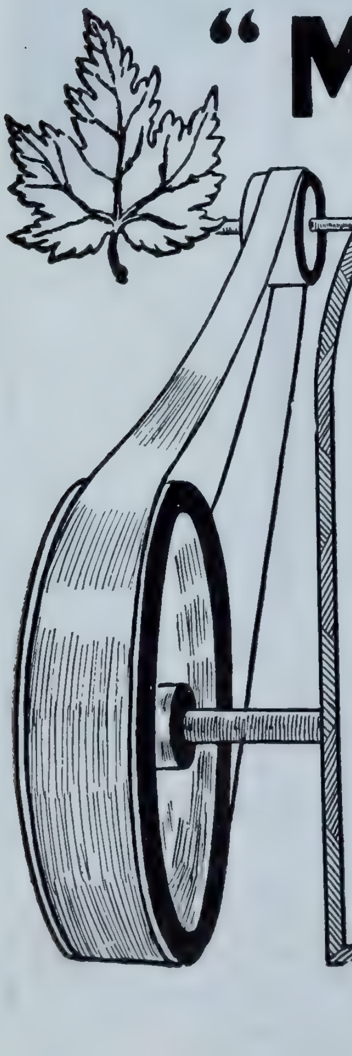
You can depend absolutely upon the strength and service of every "American" Pulley.

The American Pulley Company

Philadelphia New York Boston Chicago

Stocked and sold by dealers.

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS:—Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N. B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

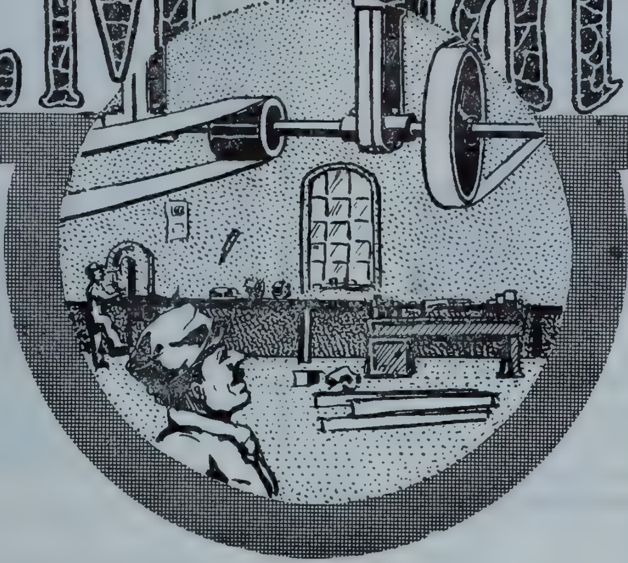
Maple Leaf Belt Dressing

The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

D. K. McLaren's

Genuine
British
Oak-Tanned



LEATHER
BELTING

A continuous round of efficiency, economy and satisfaction

The hides that form the leather of D. K. McLaren's Belting are selected by our experts in the best markets of the country. The hands through which the hides must pass during the evolution to belting leather, are also those of wide experienced men.

The great strength and durability of D. K. McLaren's Belting is the result of this experience and our Genuine British Oak method of tanning—a method that has proved its superiority again and again. The grip and flexibility give uniform and maximum speed.

This belting requires but little attention, as it is absolutely true-running and is thoroughly stretched before being placed on the market.

Many of the largest Canadian Power Houses are using it. Why do they? We'll be pleased to furnish you with names, so that you can ask them.

Better write us now.

Genuine Oak

This trade-mark guarantee is on every piece of D. K. McLaren's leather belting. Look for it.

Montreal
351 St. James St.

St. John, N.B.
64 Prince William St.

D·K·McLAREN
LIMITED

Toronto
200 King St. W.

Vancouver
847 Beatty St.

DURABLA

Registered Trade-mark Stamped all Over the Sheet

SHEET PACKING

for Superheat and High Pressure, Wet Steam and Oil.
It makes tight joints and keeps them tight.

Never pulps! Never blows out!

Manufactured by
DURABLA MANUFACTURING CO., NEW YORK

Canadian Sales Agents
CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, Calgary, St. John, Toronto
Saskatoon, Quebec, Winnipeg, Vancouver.

Up-to-the-minute methods for saving labor and expense in modern power plants.

JEFFREY
Coal and Ashes
Handling
Machinery

does away with human drudgery in the boiler-room, reduces power plant costs, and takes the dust and dirt out of the engine-room.

Let Jeffrey Engineers help to plan the equipment you need.

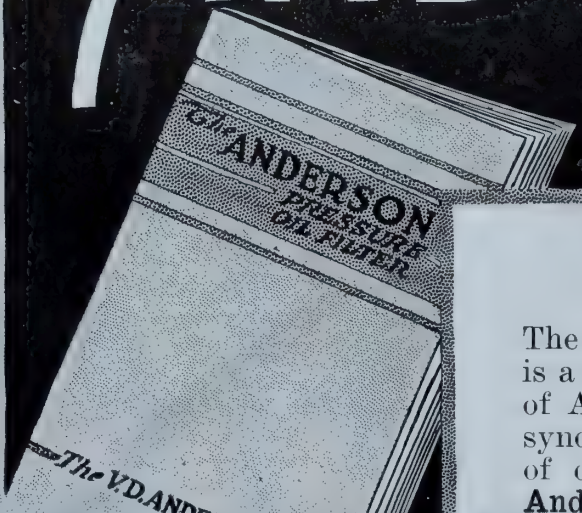
Over twenty-five years of actual field experience is our claim to knowing how.

Write for Bulletin No. 32-B.

JEFFREY MANUFACTURING COMPANY
Canadian Main Office—Cote and Lagauchetiere Streets
MONTREAL

The Anderson

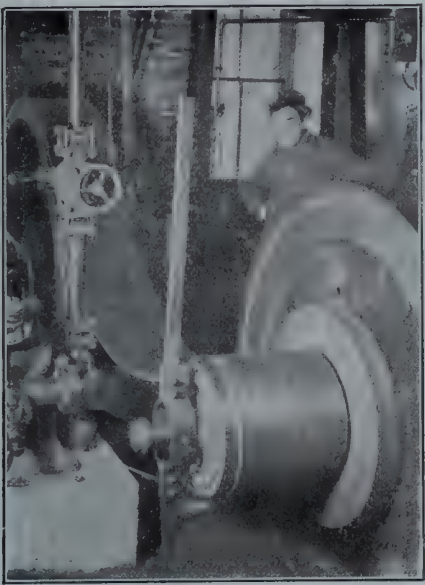
PRESSURE
OIL FILTER



WRITE FOR IT

The Anderson Pressure Oil Filter Catalogue is a brightly illustrated and lucid description of Anderson Oil Filters. It is an educative synopsis of the uses, capacity and structure of our product. Mention is also made of **Anderson Pumps, Steam Traps, Separators, Water Columns, etc.**

Manufactured by
The V.D. ANDERSON CO. Cleve'd, O.



Is There Rosin In Cling-Surface?

Cling-Surface contains *less free organic acids* than any other manufactured or natural substance suitable for the treatment of belts and ropes.

That Cling-Surface contains only the purest and most preservative materials is evident from the following reports of the highest authorities in their respective fields and countries:

Prof. Orndorf, Cornell University.

"No rosin, no free alkali, no free mineral acid, no free ammonia present."

Ernest J. Parry, B.Sc., T.J.C., F.C.S., Analytical Chemist, London:—

"Free from any matter which would have corrosive effect on leather, canvas, cotton or similar fibres. In my opinion a perfectly suitable lubricant for leather belts or fibres of any kind."

Dr. J. Gordon Parker, London:—

"No mineral acids, nor was I able to find any ingredients likely to be detrimental to leather, canvas, cotton or other belting. It acted very beneficially on belting in my laboratory."

Dr. Gartenmeister, Elderfeld, Germany:—

"No mineral or other damaging products, no tar, rosin or rosin oil. No products which would damage leather, camels hair or cotton belts or hemp or cotton ropes."

Prof E. Karsch, of Cologne, received the following report from the German Royal Material-Testing office:—

"Free mineral acids, free alkali and rosin are not present. Mineral substances, wax, rosin, rosin oil and free organic acids are not present in any quantities which can be detected."

We might continue references endlessly, but the use of Cling-Surface all over the world for sixteen years has been the best demonstration of its basic value.

Every pound of Cling-Surface is guaranteed. It must satisfactorily stop slip and preserve the belts or ropes, or you can have your money back. Write for literature.

We quote f. o. b. Toronto.

Cling-Surface the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo N Y

I am interested in Cling-Surface and your trial order proposition.

Name .... Position ....
Firm ....
Street ....
City .... State ....

58

Reasons why you should use

J-M High Temperature Cements

J-M HIGH TEMPERATURE CEMENTS	ORDINARY FIRE CLAY
Resist highest temperatures.	Can't resist high temperatures.
Never fuse.	Runs.
Never run.	Fuses.
No patching.	Requires frequent patching and repairing.
No repairing.	Extra labor.
Save 50% in maintenance cost.	Loss of time.
Save labor.	Loss of money.
Save time.	
Save money.	

J-M High Temperature Cements put an end to fire-brick troubles for all time. Tests in actual service prove that they last many times longer than fire clay.

These cements are made of Asbestos and other highly refractory materials. They vitrify quickly, forming a hard, solid wall, and withstand temperatures up to 3100 deg. Fahr.

J-M High Temperature Cements have no equal for setting up fire-brick under boilers and furnaces; cupola work, lining crucible furnaces, ladles, tilting furnaces, retorts, etc.

Tell us your cement troubles and we'll give you the proper remedy.

Write Nearest Branch for Booklet.

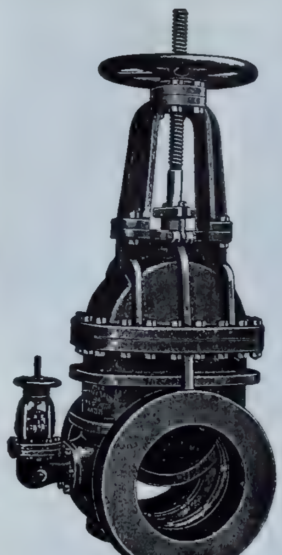
THE CANADIAN
H. W. JOHNS-MANVILLE CO., LTD.

MANUFACTURERS OF ASBESTOS PACKINGS; PIPE COVERINGS; BOILER PRESERVATIVE; CONDUIT; METALLIC HOSE; FUSES; BOILER PLUGS; STACK LINING; TUBE CLEANERS; ETC.

TORONTO **WINNIPEG**
MONTREAL **VANCOUVER**

Johns-Manville Service Covers the Continent

2151



Pratt & Cady Valves
with Renewable Bronze Seat Rings

Those who are looking for a valve of the highest grade, one which they can rely upon to help in their "Safety First" campaign, will do well to choose the P. & C. line of gate valves, made in Brass and Iron from 1¼" up; they all have the same

Retaining Ring Construction

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. These seats can be renewed by removing the retaining rings with a suitable wrench made for the purpose, or other appropriate tool. The gate is a double-faced, wedge-shaped casting, with side grooves by means of which it slides on guides in the valve body.

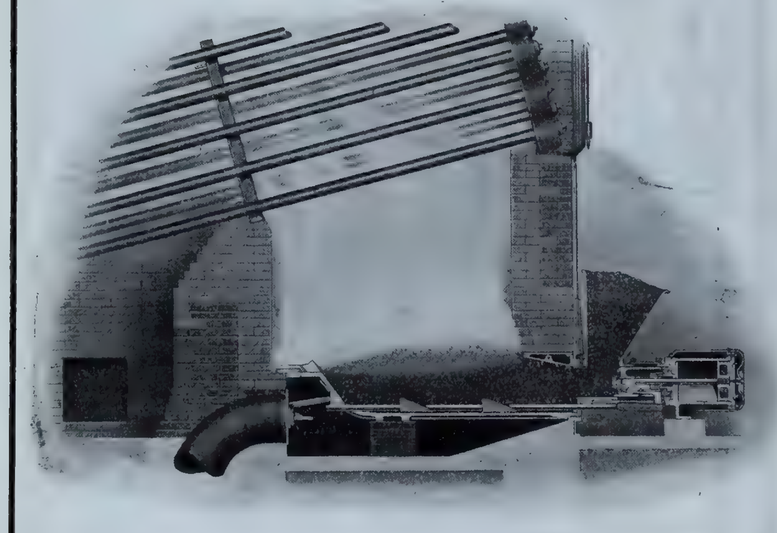
Great pains are taken in the machining of all parts of these gate valves. Gauges are used on each part to insure their accuracy and interchangeability. The guides in the bodies are of equal thickness, and the wedges can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double-seated can be used with the pressure applied at either end.

For Superheat and High Pressure, Wet Steam and Oil, use Durabla Packing.

The Canadian Fairbanks-Morse Co., Limited

Montreal Winnipeg
St. John Regina
Quebec Saskatoon
Ottawa Calgary
Toronto Edmonton
Hamilton Vancouver
Ft. William Victoria

Canada's Departmental House for Mechanical Goods



"How Can I Show Lower Operating Costs?"

Not by turning out an inferior product, which promptly "finds its level" in a reduced price!

But

By the Cheaper Production of Steam

you can "show the goods" of sterling value for less money!

It gives your whole plant a reduced operating cost!
It puts your manufactured product of standard quality on the market with increased profits.

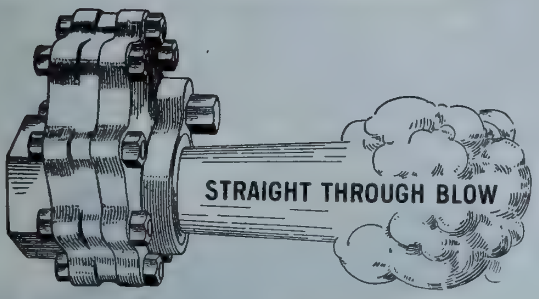
Steam is produced from 15 to 25 per cent. cheaper by boilers equipped with Jones Underfeed Stokers, and more steam per boiler without objectionable smoke.

Jones Underfeed Stoker Company, Limited

National Trust Building - Toronto

EVERLASTING

BLOW-OFF VALVES



IT NEVER LEAKS!

WRITE FOR PRICES

200,000 IN USE

Does your Boiler leak, Mr. Engineer?

How often do you blow it?

The "EVERLASTING" is the only perfect blow-off valve on the market.

No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.	CALGARY, ALTA.	VANCOUVER, B.C.	WINNIPEG, MAN.
H. L. Peiler & Co.	P. D. McLaren Limited	Taylor-Forbes Company, Limited	The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

LUNKENHEIMER INJECTORS AND EJECTORS

Efficient and durable.

Interchangeable with all standard makes.

Besides the above, the Lunkenheimer line of high-grade engineering specialties includes **Bronze** and **Iron Body Bronze Mounted** Globe, Angle, Cross, Check, Lever, Gate, Non-return Boiler Stop, Throttle, Pop Safety, Relief, Blow-off, Screw-down Check Valves, etc.; **"Puddled" Semi-steel** and **Cast-steel** Valves of all types; Water Columns, Gauges and other Boiler Mountings; Whistles and Ground Key Work of all descriptions; Lubricators and Lubricating Devices; Oil Pumps, Oil and Grease Cups; Gasoline Engine Specialties, etc.

Your local dealer can furnish them; if not, write us.

A complete description of the entire line can be had by referring to Lunkenheimer Catalogue No. 50. If you haven't a copy, write for one.

THE LUNKENHEIMER CO.

"QUALITY"

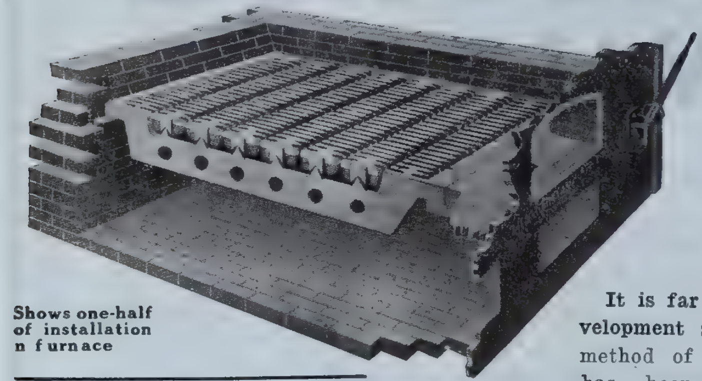
Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI, OHIO

19-43b

NEW YORK **CHICAGO** **BOSTON** **LONDON**

The McNaughton Grate



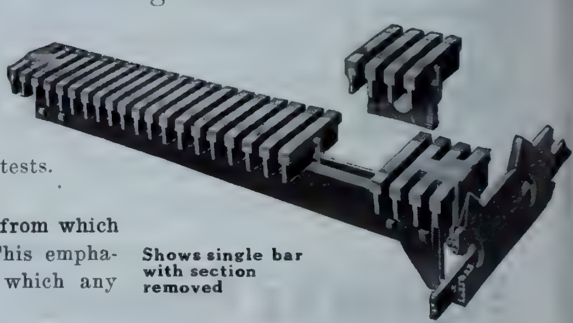
Shows one-half of installation n furnace

has a PLAN OF DRAFT SURFACE which instantly commends itself to the practical engineer.

The Draft Openings extend across the face of the whole Grate, which means that you have the maximum air space after providing the requisite structural features necessary to support the fuel without wastage.

It is far past the development stage. The method of construction has been established from the result of practical and convincing tests. It does not dump.

NOTE the Rocker Grate from which a section is removed. This emphasizes the economy with which any portion can be removed.



Shows single bar with section removed

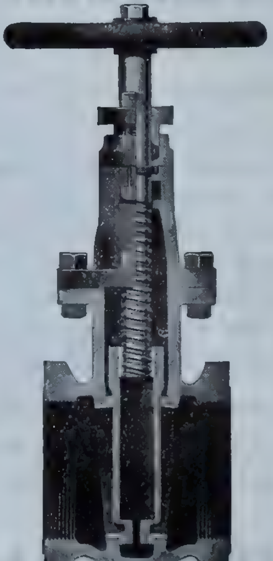
Will exhibit at the Canadian National Exhibition.
Mr. F. W. Donaldson, of 422 Euclid Avenue, Toronto, will be in charge of exhibits.
Be sure to pay him a visit.

Galt Foundry Company **Galt, Ontario**

KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

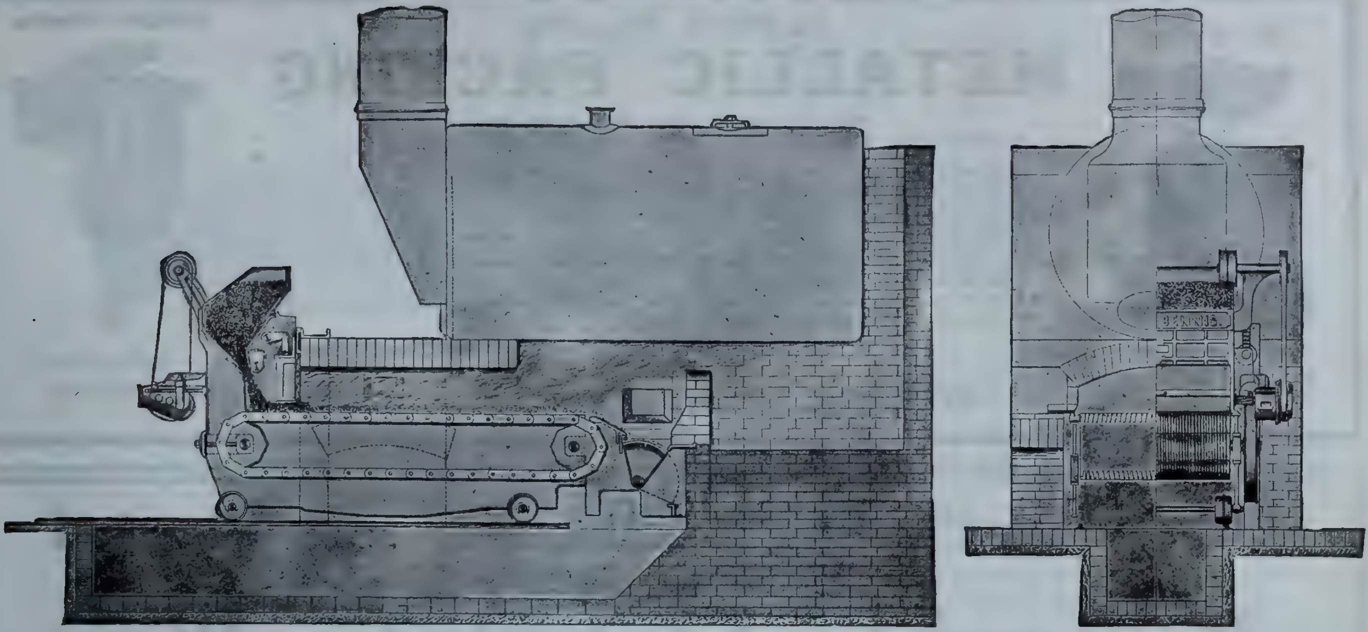


If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

The Chain Grate Machine-Stoker That Matters

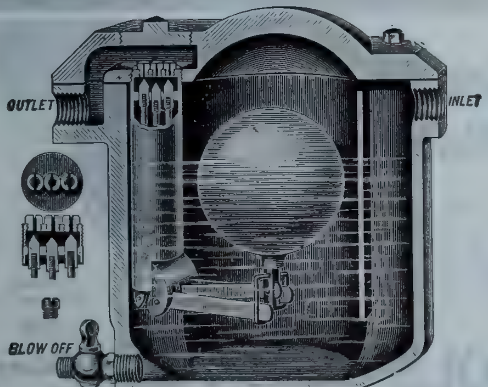


— BENNIS-PATENT CHAIN GRATE STOKER-APPLIED-TO-HORIZONTAL RETURN TUBE BOILER —

There is one machine-stoker for CHEAP steam-raising with water-tube boilers. It is the BENNIS Chain Grate, with the new Strong **Bennis** patent Long-Life-Link, which does not burn out, and keeps clear, strong fires with low-grade small fuels and slack.

Write for "Machine Stokers That Pay" pamphlets to

G. H. TOD,
213 MANNING CHAMBERS
QUEEN STREET WEST
TORONTO
Winnipeg, 601 Union Bank Building



Wright "Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

Send for Catalog.

DARLING BROS., Limited
15 Ottawa Street, MONTREAL
TORONTO WINNIPEG ST. JOHN, N.B.

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.
Send for FREE SAMPLE and particulars.

Manufactured only by
STEEL MILL PACKING CO., WINDSOR, ONT.

Practically Frictionless

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MONTREAL CANADA

Bare and Insulated Electric Wire
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire
Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

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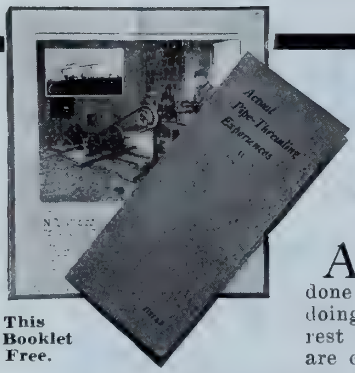

This Booklet Free.

A Small Floor-space in a Corner is Room Enough

AN unused corner in your shop can pay dividends if you equip it with an Oster. Why have your pipe-threading done outside, or waste your own time and perspiration in doing it by hand? An Oster **pays for itself** quickly, and the rest is **your** profit. Men who are determined to cut costs are choosing

OSTER Pipe-Threading TOOLS

Owners of No. 304A have proved that using this machine **only two days each month** pays 35% on the investment. Do you know now what your pipe-threading is costing you? Compare your own case with the dollar-and-cents facts in the above book. This is a book of actual experiences, and tells the truth on every page. Write for your FREE copy today and receive it by return mail.

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Supply houses in
29 Cities in Canada
handle this famous line of tools. Ask for this list of cities and see how closely it puts you in touch with an Oster.

OSTER
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Kindly send me a FREE copy of "Actual Pipe-Threading Experiences," and name of nearest dealer.

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Business ....
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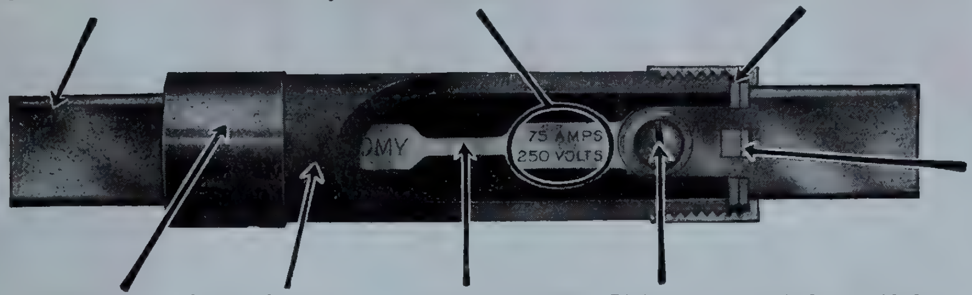
The coupon brings you the actual experiences of others. Use it today.

Round edge hard drawn copper.

Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.

This venting feature allows no fire to escape, even on severe short circuits.



Washer assembly centres, locks in position and aligns blades.

Heavy solid brass cap.

Unusually heavy gray horn fiber shell.

Short, active length of element assures uniform performance.

Links are attached to blade member by heavy machine screws.

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
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Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

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ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

Across Canada

with the

IMPERIAL WIRE and CABLE COMPANY, LIMITED

Seventh of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the

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This building was wired with "Adanac" Rubber Insulated Wire.

Architect, W. T. Whiteway, Vancouver.
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Electrical Contractor, J. G. Sutton, San Francisco, Cal.

Address enquiries to nearest office

Northern Electric Company

LIMITED

Montreal	Winnipeg	Edmonton
Halifax	Regina	Vancouver
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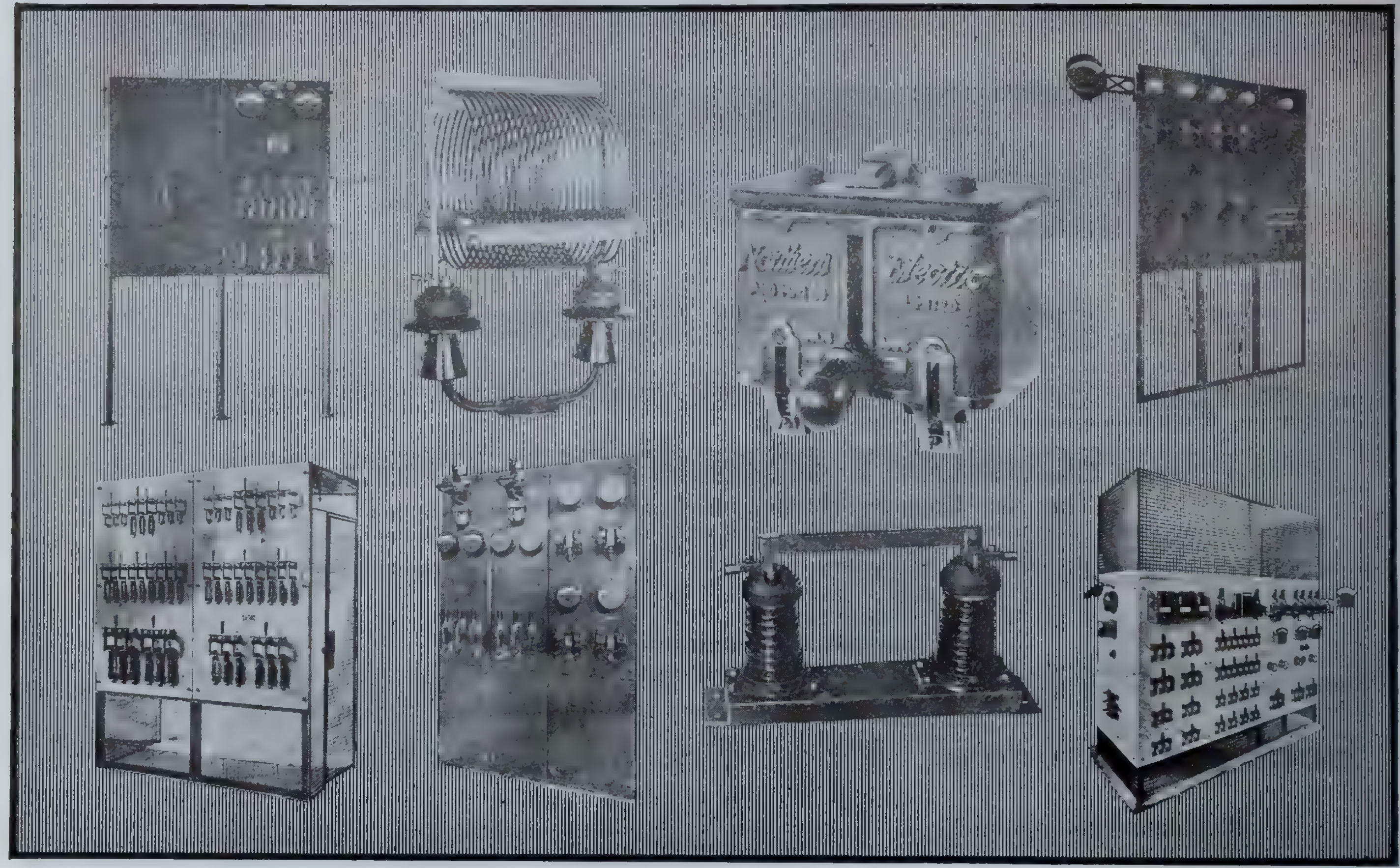
Successors to
Imperial Wire and Cable Co., Limited.
Correspondence previously addressed to the Imperial Wire & Cable Co., Limited, at 611 C.P.R. Building, Toronto, and 902 Electric Railway Chambers, Winnipeg, should now be addressed to Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave. West, Winnipeg.



Switchboards **Disconnecting Switches** **Choke Coils** **Circuit Breakers**

Designed to Suit Any Special Requirement

When special apparatus is required for electrical work of any kind we can always supply your needs.

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Our staff of experienced engineers is at all times at your service.

Consult with our specialist at our nearest house or write for information. This will not obligate you in any way and we will be glad to help you.

Northern Electric Company
LIMITED

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SUNBEAM

Mazda Lamps

(Made in Canada)

> **"I do not know much about the science of political economy, but I do know this—that when we buy goods made in a foreign country, we get the goods and the foreigner gets the money, but when we buy goods made at home, we get both the goods and the money."**
>
> —*Abraham Lincoln*

Besides getting goods that are made in Canada and keeping the money in the Dominion when you buy from us, you get lamps that are superior to those imported into Canada.

Sunbeam Incandescent Lamps are more ruggedly made, and give a better light—a light that is Canadian.

Sunbeam Lamps are made by Canadian labor in a Canadian factory, in Canada—and they are cheaper, quality considered, than those of foreign manufacture.

Let us prove the quality of our goods. **Send a trial order.**

The Canadian Sunbeam Lamp Co., Limited

Main Office and Factory: TORONTO

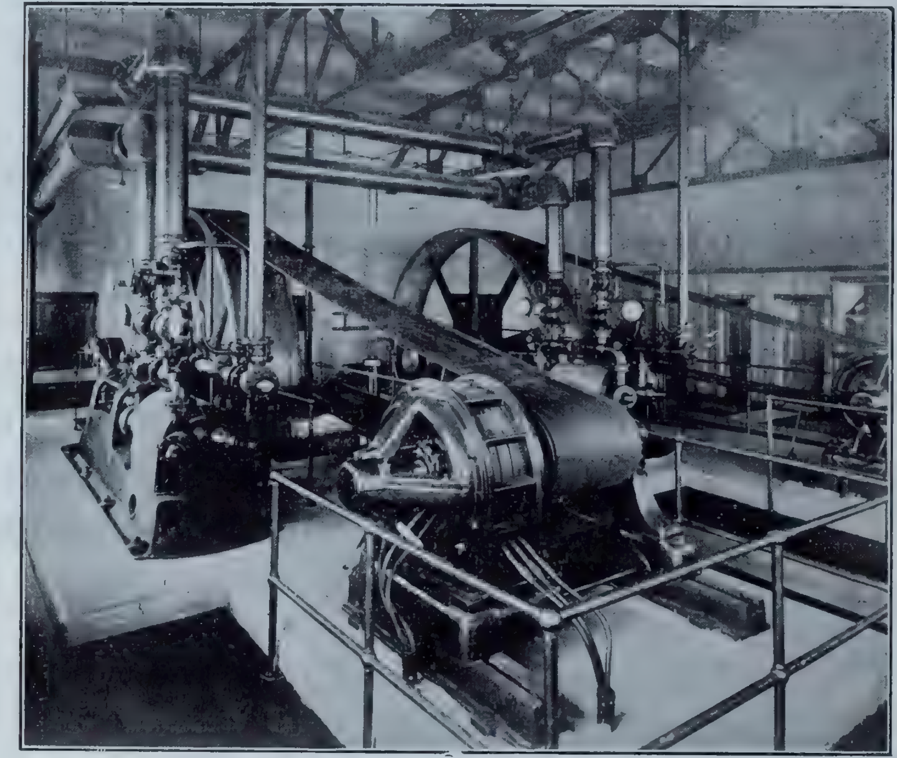
Branch Warehouses: MONTREAL, WINNIPEG, CALGARY, VANCOUVER

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt-Driven, Double-Acting, Horizontal Ammonia Compressors Manufactured and Installed by Us in Canada.

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

Overhauls and repairs by competent engineers.

Catalogues and estimates upon request.

The Linde Canadian Refrigeration Co.,

Limited

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Branch Offices—Toronto, 23 Scott St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, Tegler Building; Calgary, 407 P. Burns Building.

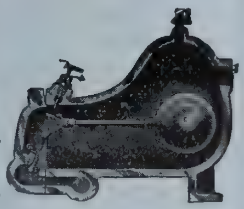
McDANIEL IMPROVED **STEAM TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.

USE THE BEST

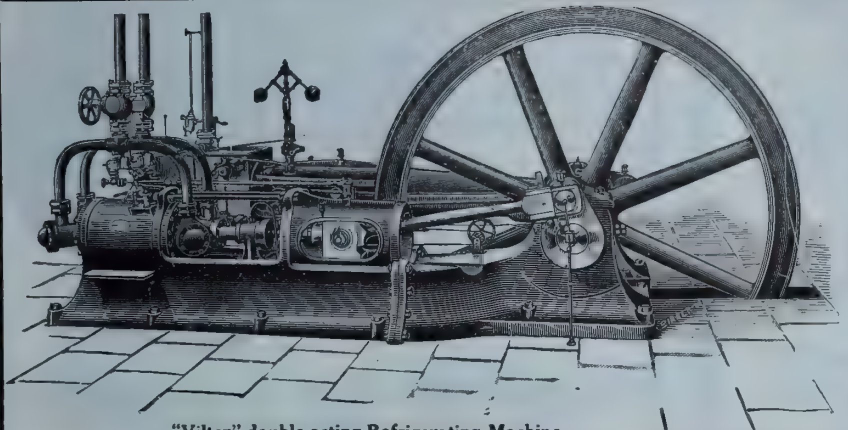
ANHYDROUS AMMONIA
"EXCELSIOR" BRAND

100% EFFICIENCY

MANUFACTURED ONLY BY

Canadian Ammonia Co., Ltd.
TORONTO, ONT. DETROIT, MICH.

STOCK CARRIED IN ALL
PRINCIPAL CITIES IN CANADA



"Vilter" double-acting Refrigerating Machine

Established 1867

The VILTER MFG. CO.

242 Becher St. Milwaukee, Wis.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES
ICE AND REFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

Write for Catalogue and full Particulars

Chicago Office: 731 Monadnock Bldg.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration.

De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and many of our machines installed over twenty years ago are to-day maintaining their high initial performance.

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name De La Vergne stands for highest quality, maximum capacity, absolute reliability and permanent economy.

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

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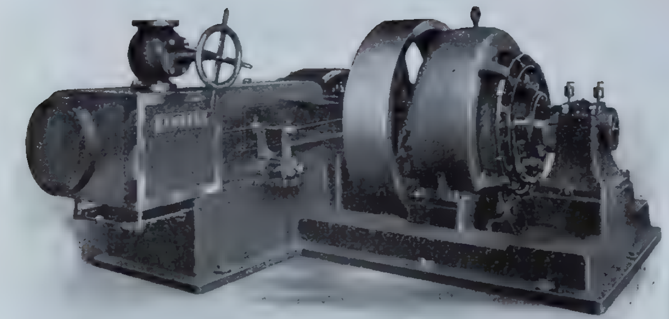
TORONTO, Canada



"RUSSELL"

Enclosed Self-Oiling, Single-Valve, or Semi-Corliss

STEAM ENGINE

Direct-Connected Style—Rear View

Specially adapted for direct connection to electric generators, general power work, and any service involving continuous operation. **Economical in steam and oil consumption; every pin and bearing readily adjustable.** Made in two styles, simple and compound. **Seventy years of successful engine building stands behind these machines.**

Write for bulletin No. 802, Single-Valve.
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The Canadian Griscom-Russell Company, Limited

Engineers and Manufacturers

701 Confederation Life Bldg., Toronto
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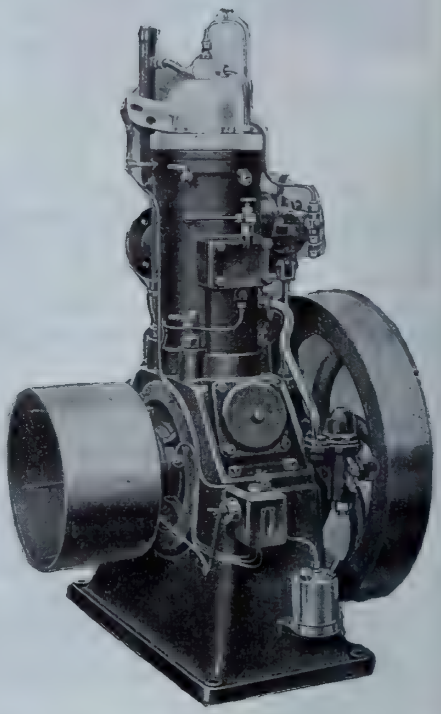
MUNKTELL
CRUDE OIL ENGINES

Economical in working and upkeep. Simple in construction and requires minimum attention. Workmanship and material of the highest order.

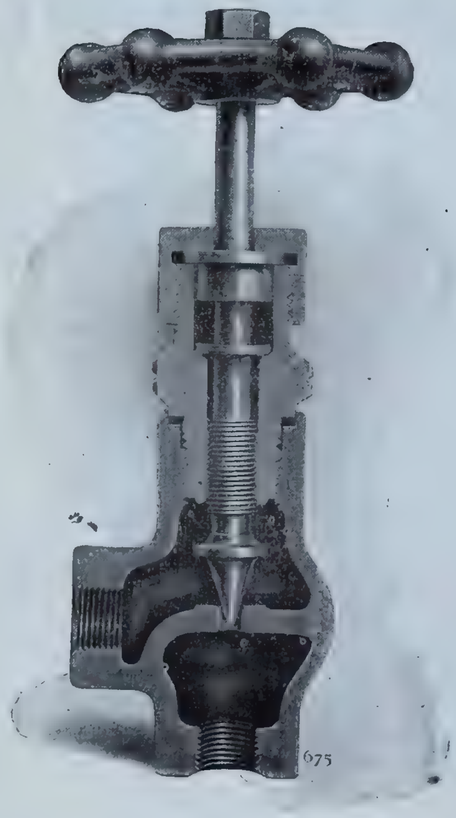
Built in Canada in a modern shop under the supervision of a well-known expert and authority on oil and gas engines.

Prices moderate.

Write for fully illustrated booklet and information.



OIL MOTOR and MFG. CO., LIMITED
ST. JOHN, N. B.



YORK AMMONIA EXPANSION VALVES

Have Taper Seats.

Can be closed tight.

Will give close regulation.

Have Hardened Stems, ground to gauge—insuring uniform flow in Expansion Headers.

These Valves are carried in stock by

CANADIAN ICE MACHINE COMPANY

TORONTO, 163-167 Yonge Street.
MONTREAL, 324 Coristine Bldg.
WINNIPEG, 302 Donalda Bldg.

YORK MANUFACTURING CO.

(Ice-Making and Refrigerating Machinery exclusively)

YORK, Pa., U.S.A.

J. V. Jamison, President. **T. B. South,** Vice-President. **J. V. Jamison, Jr.,** Treasurer.

Change of Name

On and after September 1st, 1914

Jones Cold Store Door Co.

will change its corporate name and will thereafter be known as—

The Jamison Cold Storage Door Company

HAGERSTOWN, MARYLAND

No change whatever will be made in the organization or the business of the Company. The personnel of the management and the sales and shop force will be the same as it has been since 1907.

Worth Your Study

ARCTIC ICE MACHINERY

The Ammonia Compressor guaranteed to produce 20% over-capacity as compared with any other Horizontal ice machine of equal size on earth—it's a mighty interesting proposition. Bulletin 1-P explains the construction.

ARCTIC-POWNALL RAW WATER ICE PLANTS

Are causing orders and inquiries from all parts of the world—and the sparkling purity and freedom from taste or odor of this ice deserve the popularity it has achieved. Ask for full particulars.

"WE DO IT RIGHT."

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

THE H&C SAFETY

The Largest Ice Dealer in Detroit Installed Two H. & C. Safetys a Year Ago.

Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

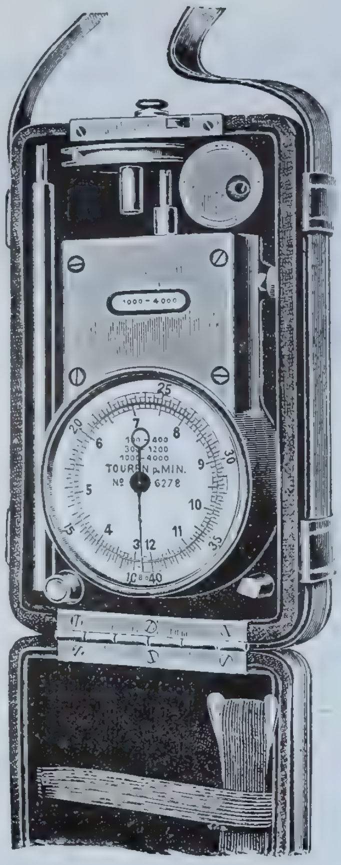
During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of **6 3-10 K.W. per ton or more than 11½% saving in power consumption.**

You, Mr. Iceman, should check up on your costs and capacity against these records.

Write us to-day for a Pittmans & Dean chart of their year's results.

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Refrigerating and Ice-Making Machinery
DETROIT 42nd Year. MICHIGAN



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(DR. HORN'S LATEST IMPROVED TYPE)

**Excellent Quality
—Moderate Prices**

Hand and Stationary Instruments Suitable for all Purposes.

TESTING TACHOGRAPHS

Exceedingly Sensitive, Will Record the Slightest Change in Speed of Machine.

TACHOSCOPES

A Revolution Counter and Centre Second Stop Watch Combined to Operate Simultaneously.

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MOOSE JAW
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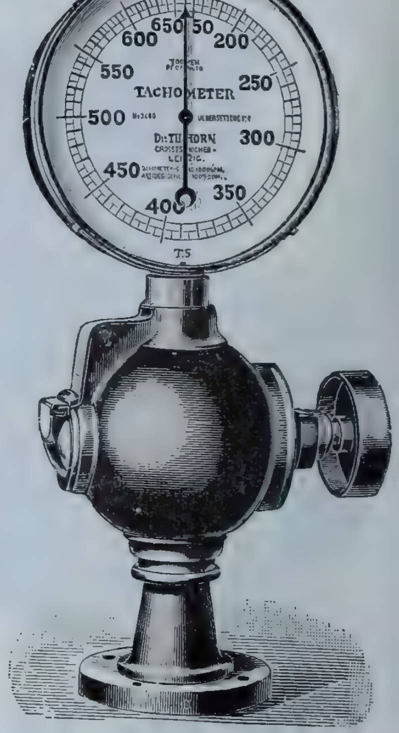
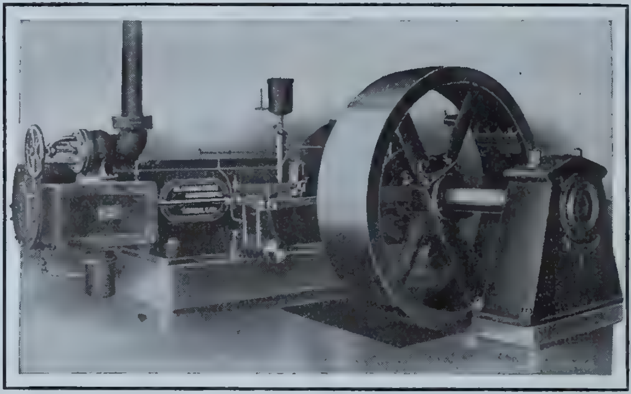




Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

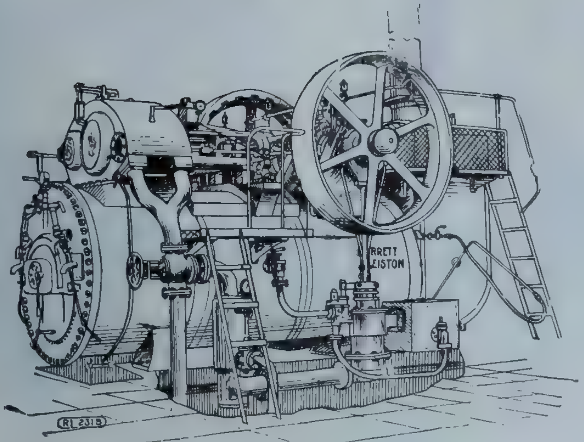
High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

STEAM ENGINES

With Gas Producer Economy **Steam Engine Reliability**



THE GARRETT (SUPERHEATED STEAM SEMI-STATIONARY) ENGINE.

Require only 1¼ Lbs. OF COAL PER B. H. P. HOUR.

Sizes 40 H.P. to 250 H.P.

Can use any kind of fuel Anthracite, Bituminous, Lignite, Wood, Shavings, Sawdust, Oil or Gas.

Just the Power for the Small Town. Electric Light or Pumping Plants. Mills or Factories.

Efficient, Reliable, Economical.

Correspondence Solicited.

Theodore Kipp Company

Union Trust Building **Winnipeg, Man.**

JUST RECEIVED

At our Winnipeg Warehouse

A Car of E.C.C. Motors

MANUFACTURED BY

The Electric Construction Co.
WOLVERHAMPTON

These Motors are three-phase, sixty-cycle, 220 and 550 volts. Sizes over 5 H.P. complete with Auto Starter.

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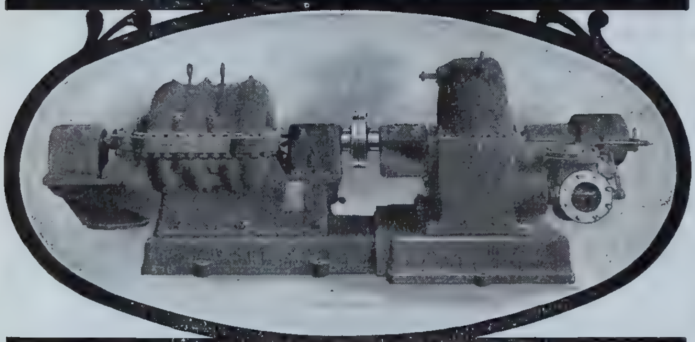
For information write

THE CANADIAN BRITISH ENGINEERING CO., Ltd.

4 Queen Victoria St., London, E.C. **324 Smith St., Winnipeg**

DE LAVAL
Steam Turbine Driven Centrifugal BOILER FEED PUMPS



De Laval Steam - Turbine - Driven Centrifugal Boiler-Feed Pumps

AMONG many of the advantages of steam-turbine-driven centrifugal boiler feed pumps are:

(1) Extreme simplicity and low cost of maintenance, due to the absence of packings and of sliding surfaces.

(2) Entire absence of shocks, pulsations and irregularity of flow in the pipe lines. This is especially desirable where Venturi or Pitot Tube feed-water meters are employed. Records made by such meters in connection with reciprocating pumps are often illegible.

(3) The steam end of the unit is not only more economical than is the steam end of a reciprocating pump, but may be utilized to improve the overall thermodynamic efficiency of the plant, as by (a) running on low-pressure steam from other auxiliaries and exhausting to condenser; (b) utilizing steam from the intermediate receiver of the main engine; (c) running on high-pressure steam and exhausting to heating and drying systems, etc. The turbine may also be of the mixed-flow type, able to operate on either high or low-pressure steam, condensing or non-condensing.

(4) It occupies much less space and is able to handle hot water successfully.

The particular merits of the De Laval Turbine-driven Centrifugal Boiler Feeder include:

(1) Easy access to rotating parts of either pump or turbine by lifting casing cover and without disturbing piping connections.

(2) High efficiency of both pump and turbine.

(3) Extreme simplicity of both pump and turbine. There are no diffusion vanes in the pump and no internal diaphragms in the turbine.

(4) Ready and inexpensive renewability of all wearing parts without disturbing or replacing heavy or expensive parts.

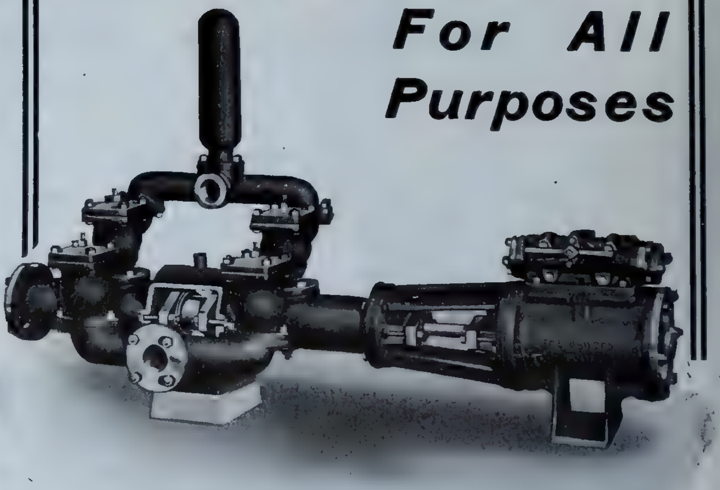
De Laval pumps and turbines are built in all sizes and for all purposes, including water-works pumps, general service pumps, hydraulic pressure pumps, hot water circulating pumps, etc. Also multi-stage turbines for direct connection to high-speed machinery such as alternators and compressors, or through the De Laval Gear to low-speed machinery, such as direct-current generators, rope and belt drive, etc. Single-stage turbines for driving all kinds of machinery through gears and the De Laval velocity-stage turbine especially adapted for driving power plant auxiliaries.

State which subject you are interested in and ask for our general Catalog No. "C-61."

DE LAVAL
STEAM TURBINE CO.
Trenton 111 **New Jersey**

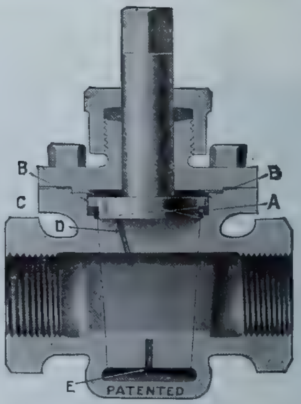
Turbine Equipment Co., Ltd.
204 Peterkin Bldg, Toronto, Canada
MESSRS. TAYLOR & YOUNG,
513 Pacific Bldg. - - - - - Vancouver, B.C.

Bawden Pumps
For All Purposes



Cannot Short Stroke, Never need Adjusting, no Springs, Tappets or Packing in Steam End, no Bang at any Speed or Pressure, all Faces Machined.

The Bawden Machine Co., Limited
133 STERLING ROAD TORONTO, CANADA



A Guaranteed Valve
For Every Purpose

Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

Send for Catalog "R."

Homestead Valve Mfg. Co.
Works: Homestead, Pa. Pittsburgh, Pa.

Improved "SAMSON"

Turbine Water Wheel

Is noted for the very high efficiency it attains.

In official, independent tests conducted at Holyoke, Mass., which is the only recognized testing flume in America, it has shown efficiencies ranging as high as 89.99% at from ¾ to ⅞ gate. **These results are better than** any other wheel built in Canada has ever shown, and on this account, we claim that it is the foremost Canadian-built wheel on the market.

The "**Samson**" Wheel, to develop this efficiency, is also necessarily of modern design, as it competes successfully in respect of efficiency with all of the foremost wheels built either in the United States or Europe.

As generators are usually driven by water wheels of sufficient capacity to deliver the normal generator load at from ¾ to ⅞ gateage, it will be seen that the point of most frequent operation of the wheel is also the point of the Samson's highest efficiency.

The comparative efficiencies at Holyoke shown by different wheels is an accurate indication of the work they will do in actual operation, and it follows from this that the "Samson" Wheel will give **exceptionally good results under all working conditions.**

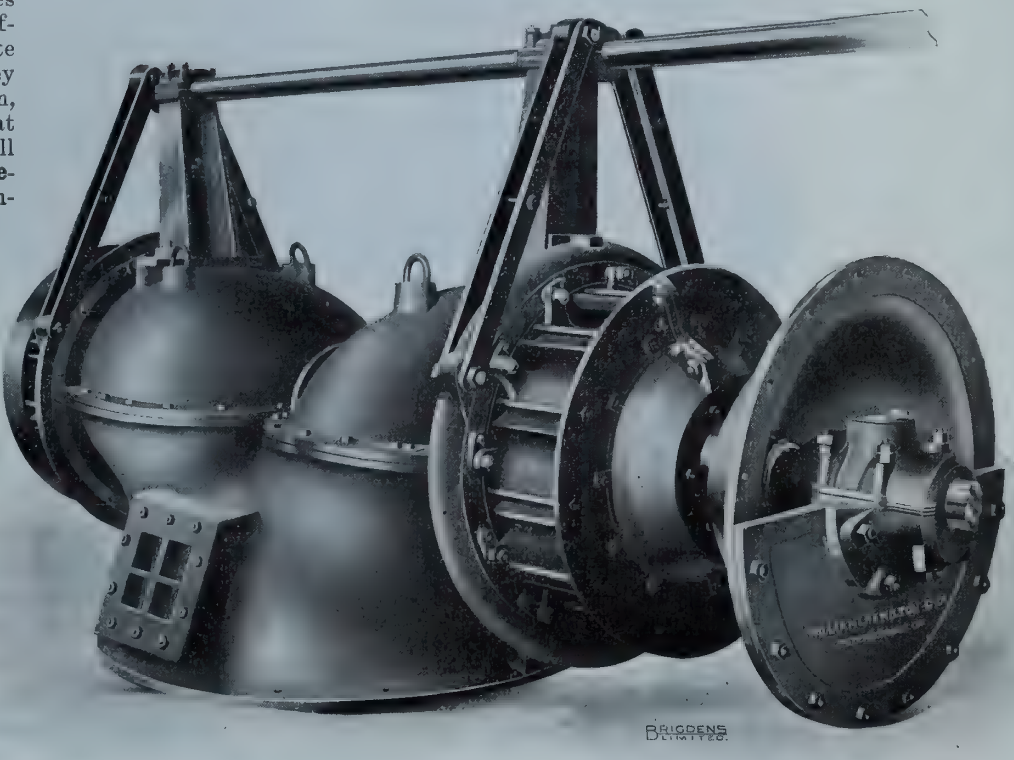
The "Samson" wheel is extremely durable, and is very strongly built. The buckets are of flange quality steel plate, cast into the body of the runner. A number of small holes are drilled in the edge of the buckets where they go into the casting, and when the casting is formed the molten metal runs through these holes, literally pinning the buckets into the casting, and making it quite impossible for them ever to pull out or become loose.

We have had over **twenty years'** practical experience at this work, and the knowledge gained during this experience has enabled us to build a wheel that is surpassed by none, at a very reasonable price.

Write for Catalogue and full particulars.

Wm. Hamilton Company, Limited

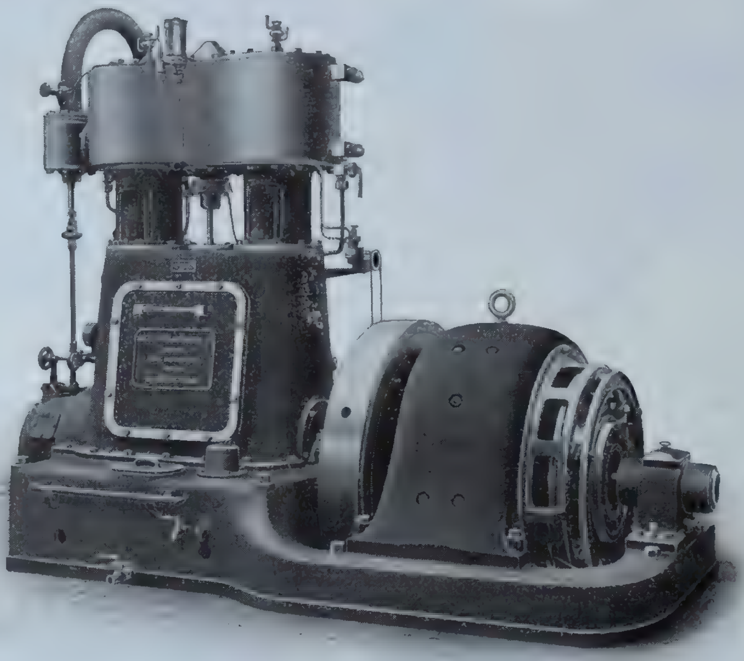
Sole Builders in Canada. **PETERBOROUGH, ONTARIO**



BELLISS & MORCOM, Ltd.

HIGH-SPEED ENGINES and COMPRESSORS

OVER 150 OF THESE SETS INSTALLED IN CANADA



250 B.H.P. Belliss & Morcom High-Speed Engine

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Engineers

212 Board of Trade Bldg. MONTREAL

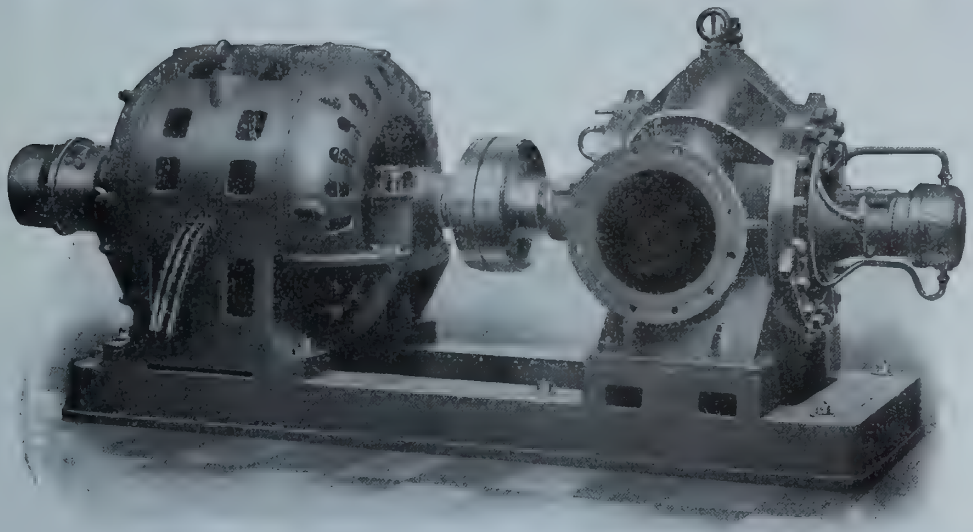
W. H. ALLEN, SON & COMPANY

LIMITED

QUEEN'S ENGINEERING WORKS, BEDFORD, England

ENGINEERS AND BUILDERS OF

Steam, Hydraulic and D.C. Electric Machinery



"CONQUEROR" PUMPING MACHINERY

Five million Imperial gallons per day; variable pressure 50 to 128 pounds per square inch; 450 B.H.P. Motor; 1800 r.p.m. — for

CITY OF WINNIPEG

For prices and full particulars, apply to head office at

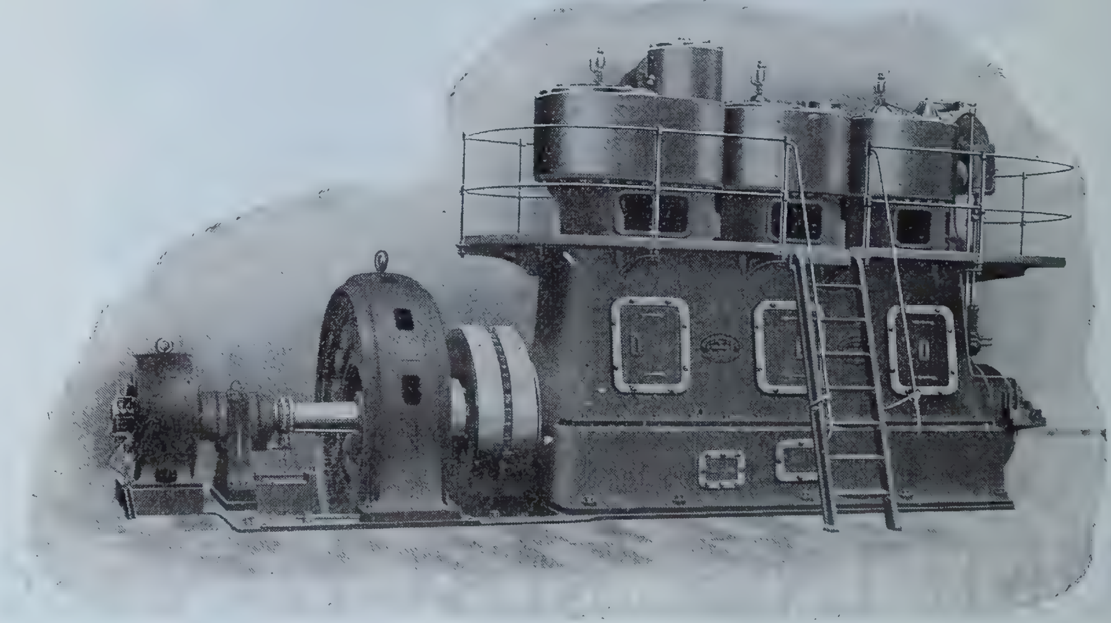
BEDFORD, England

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.

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We offer for

IMMEDIATE

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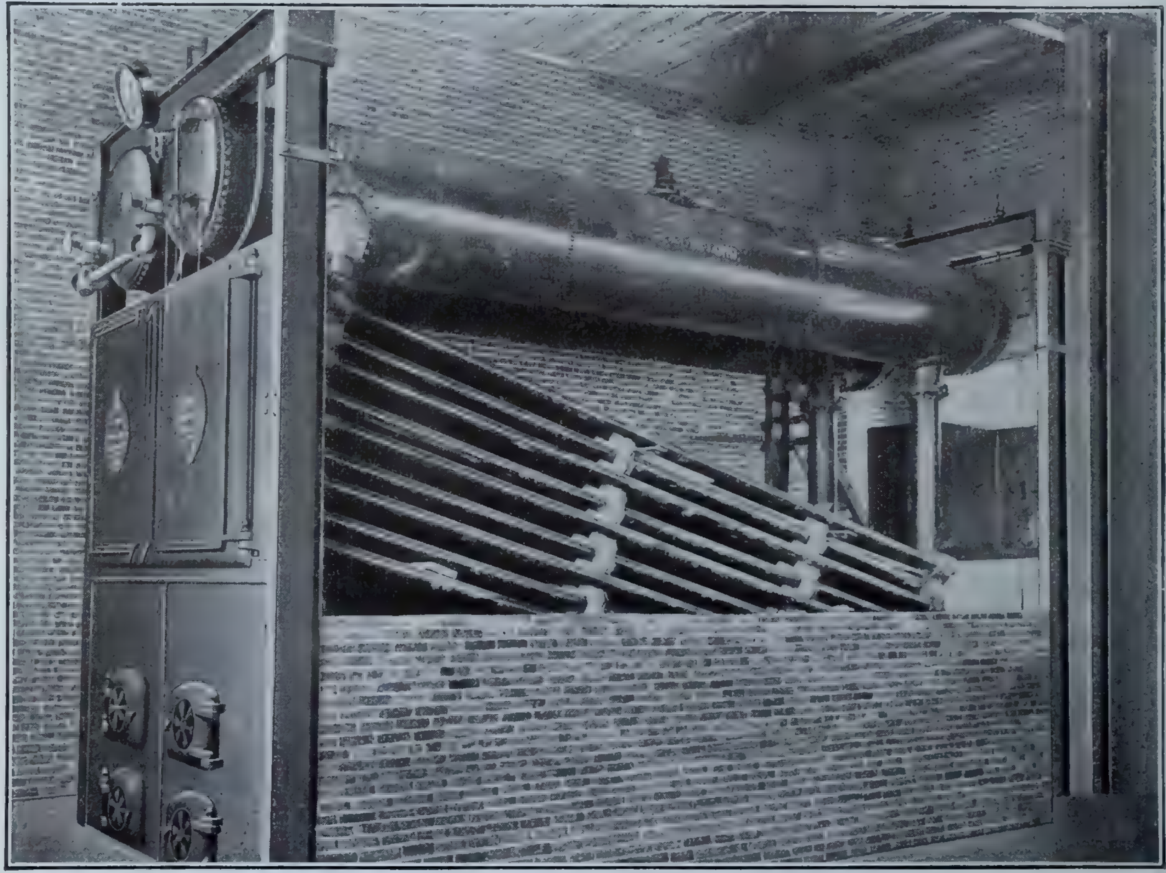

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Power, Light and Heat Plant of a Departmental Store

Staff Article

As would naturally be expected, where the intention was to have as far as possible absolute independence of operation, and at the same time comfort and contentment of employees, a departmental store of high repute like that of the Robert Simpson Co., Toronto, must necessarily embrace within its organization a modern and efficient plant for its power, light, heat and refrigeration requirements. That such is the case will be noted in the accompanying article.

THE departmental store of the Robert Simpson Co., Toronto is one of the largest in the Dominion, and the requirements of such an establishment are necessarily many and varied. The store is self-contained as far as mechanical equipment is concerned. Light and power is generated on the premises, while a refrigeration plant is installed to take care of the large fur storage room, the grocery department, and to manufacture ice for the restaurant kitchen and drinking water purposes.

The boilers and generating sets are installed in a large room, the floor of which is 38 ft. below the street level. In this room are also installed the boiler feed and vacuum pumps, refrigeration plant, the switchboard, and a number of machine tools, enabling the engineering staff, of which William Dutton is the chief, to execute at least minor repairs. In the sub-basement under this room are the elevator pumps, tanks, and various auxiliaries.

Boiler Installation, Etc.

VIEW IN BOILER ROOM.

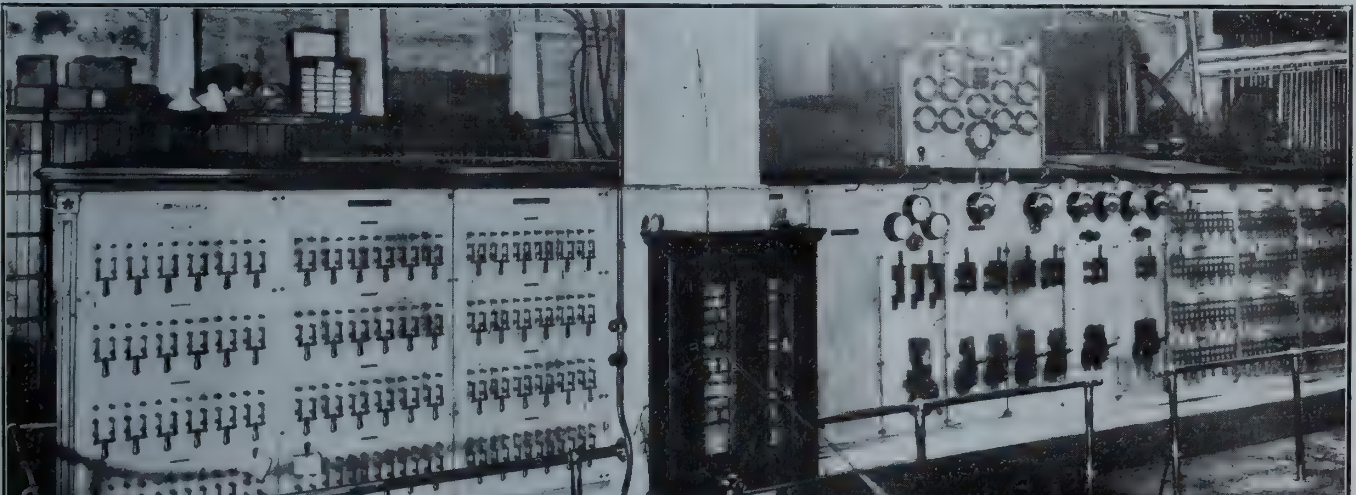
The boiler installation consists of four water-tube boilers arranged in two batteries. Two of these boilers are each of 250 h.p. and are fitted with **Green** water-cooled chain grates. The second battery consists of two **Babcock & Wilcox** boilers, each of 320 h.p., fitted superheaters giving 130 degs. of superheat, and equipped with **Babcock & Wilcox** chain grates, 6 ft. by 10 ft., for burning bituminous coal. All the chain grates are operated by a 6 h.p. **Reavell** vertical engine, with an electric motor as an auxiliary. The working pressure for all boilers is 200 pounds. **McDonough** damper and feed water regulators are installed.

The steam pipes have extra heavy fittings and are equipped with **Crane** valves. The main header is 10 in. diameter, the steam pipe to the elevator pumps is 6 in. diameter, and the steam pipes to the engines are 5 in., 4 in., and 3 in. diameter respectively. The kitchen and hot water service heater are supplied with live steam reduced from 200 to 55 lbs. by **Kieley** reducing valves. All the steam pipes are covered with 90 per cent. magnesia covering supplied by Philip Carey & Co., Toronto.

Pumping Installation

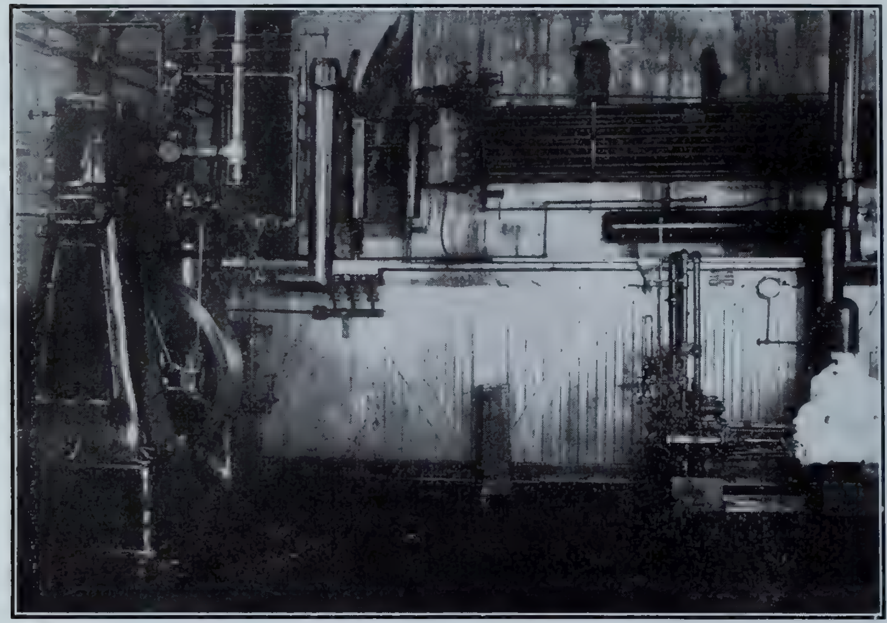
The boiler feed pumps are situated near the boilers, as are also the vacuum pumps for the steam heating system. There are two **Smart-Turner** 7½-4½-10 in. outside packed boiler feed pumps and two **Burnham** vacuum pumps, 12-6-20, with a smaller type **Burnham** pump as a reserve.

The building is heated on the **Webster** exhaust steam system, **Kieley** reducing



SWITCHBOARD, THE ROBERT SIMPSON CO. DEPARTMENTAL STORE.

valves being installed in the steam line, in the event of it being necessary to use live steam. A 1,000 h.p. **Cochrane** feed water heater is installed and was supplied by the Canadian Allis-Chalmers, Ltd., Toronto.



REFRIGERATING EQUIPMENT, ROBERT SIMPSON PLANT.

A fire protection system throughout the building consists of a number of stand pipes and a sprinkler system. In connection with this system is an **Underwriter** pump 18, 10, 12 in., having a capacity of 1,000 gallons at 70 r.p.m.

Engines and Generators.

The electric light and power installation consists of three high speed engine and generator sets, the largest being a 200 h.p. compound vertical engine running at 420 r.p.m. and fitted with piston valves, forced lubrication, steam and oil pressure gauges, tachometer, and enclosed crank shaft governor. The engine was built and installed by James Howden & Co., Glasgow, Scotland, and is direct connected to a 200 k.w. 250 volts, d.c. interpole, compound wound generator supplied by Bruce, Peebles & Co, Edinburgh, Scotland.

The second unit consists of a 150 h.p. **Robb** vertical compound engine, with cylinders 11 in. and 17 in. diameter by 10 in. stroke, running at 300 r.p.m. This engine is direct connected to a Canadian General Electric Co. 100 k.w., interpole, 250 volts, d.c. generator. The third unit consists of a 75 h.p **Robb** vertical compound engine, with cylinders 8 in. and 14 in. in diameter by 8 in. stroke, running at 350 r.p.m., and direct connected to a Canadian General Electric Co. 50 k.w. compound wound, 250 volt, d.c. generator. The **Robb** engines were supplied by the International Engineering Works, Amherst, N.S.

Switchboard.

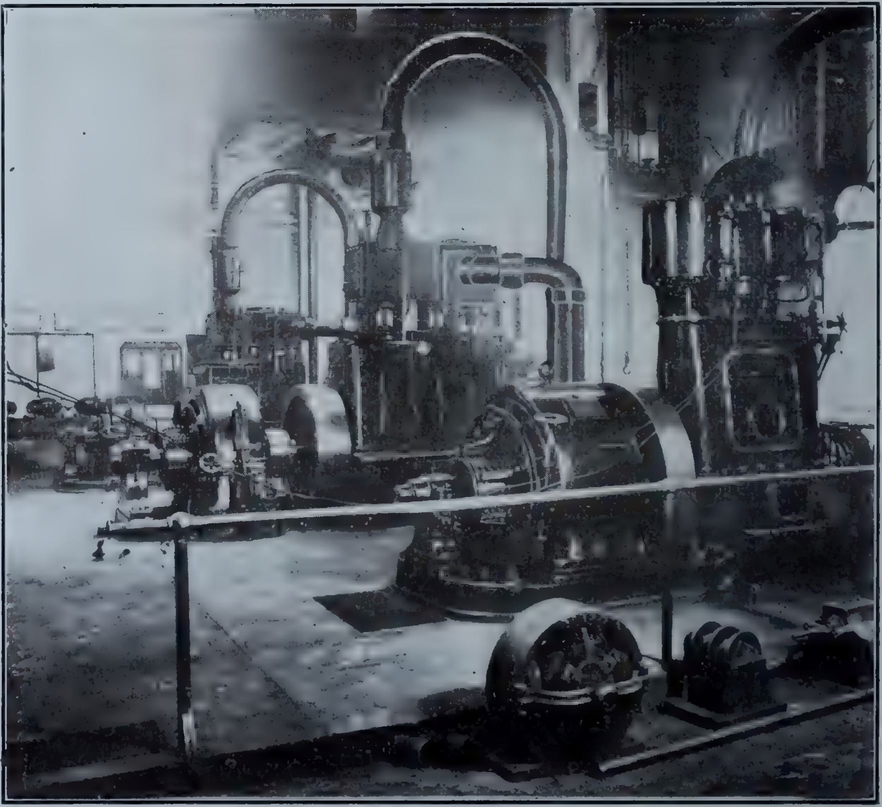
The switchboard is of large dimensions, as all the lighting and power circuits are controlled from the engine room where the switchboard is located. The board is 44 ft. long by 6 ft. 6 in. high, and has 15 marble panels made up as follows:—One panel for each floor and the basement; one for auxiliary lighting; one for controlling the various motors throughout the building; three generator panels, and two connected up with outside power lines, there being from 50 to 100 k.w. of current from this source utilized. The switchboard is equipped with the usual instruments and double pole circuit breakers on the generator panels. All switches are double throw type, so that current from outside can be used in any circuit if necessary.

Above the switchboard is a gauge board equipped with a number of gauges for the following purposes:—City water pressure, pressure in sewerage ejector air tank, pressure in elevator tanks, vacuum in heating system, pressure gauge for each boiler, recording steam pressure gauge, pressure in carpet cleaning system and a clock. On the board is an annunciator in connection with the fire protection system. An alarm sent in from certain points in the building rings an alarm bell and an indicator shows the location of the alarm.

Adjoining the main switchboard is a single panel board from which the various circuits supplied from the motor generator set are controlled. These units include the cash system, time bells, fire alarm and call bells. There are two **Sprague** motor generator sets equipped with **Lundell** motors. They are both of the same size, having 1¾ h.p. motors, direct connected to one k.w. 20 volt generator running at 1900 r.p.m.

Auxiliary Equipment.

In the sub-basement under the engine room is installed the auxiliary equipment, elevator pumps, pressure tanks, ash conveyor, etc. The latter is, of course, located near the boiler ashpits and consists of a screw conveyor, with a bucket con-



ENGINES AND GENERATORS. ROBERT SIMPSON CO. PLANT.

veyor for raising the ashes to the street level. The apparatus was supplied by the Jeffrey Manuacturing Co., Columbus, Ohio.

A receiver and pump are installed to take care of all the drains from **Anderson** steam traps fitted in all live steam lines. All the exhaust steam lines are also equipped with **Anderson** return traps, forming a separate system from the above. In the former system, the drains are returned to the feed water heater by a 4-7-10 in. pump, while in the latter the returns go direct to the heater.

The boilers are blown off into a tank which drains into a well. From the well the water is pumped to the sewer by a 2½ in. **Smart-Turner** centrifugal pump direct connected to an 11 h.p. Canadian Westinghouse electric motor.

The lavatories in the basement are below the sewer level and, in order to take care of the effluent, a **Shone** sewage ejector is installed. The ejector is operated by compressed air at 25 pounds pressure from a tank supplied with air from a Canadian Westinghouse railway type 8-15-10 in. compressor. The ejector is fitted with a float and operates automatically, the float releasing the air when the ejector is full and discharging the contents into the sewer.

A pneumatic cash system is installed throughout the store, and is supplied with air from two blowers installed in the engine room. The blowers are both No. 6 **Roots** type, and each is driven by a 35 h.p. C. & C. motor, 250 volts d.c.

The engine room is ventilated by a **Sirocco** fan installed in the sub-basement. The fan is driven by a 7 h.p. vertical steam engine and was installed by the International Engineering Works, Amherst, N.S.

Elevator System.

A store of this size requires an extensive elevator system. The Standard Plunger Elevator Co., of New York, installed 21 hydraulic elevators and the pumps for operating them. The pumps were made by the American Steam Pump Co., Battle Creek, Mich. The pumping installation consists of two **Marsh** steam pumps, one being of the compound type, 14-22-14-20 in., and the other of the simple type, 20-14-20 in. Each pump has a capacity of 500 Imperial gallons per minute and supplies six pressure tanks for operating the elevators. The tanks are normally two-thirds full of water and one-third air and carry a pressure of 200 pounds. Air for the pressure tanks is supplied by two Canadian Westinghouse railway type air pumps, 9½-8½-10 in. The steam valve of each pump is fitted with a **Mason** regulator operated by water from the pressure tank system. The regulators are very sensitive and stop the pumps immediately the pressure in tanks reaches 200 pounds.

An auxiliary pumping set is installed in connection with the elevator system, and consists of an **Escher Wyss** turbine pump direct connected to a 300 h.p. **Siemens** double commutator motor running at 1,400 r.p.m The pump has a capacity of 1,500 gallons per minute against a pressure of 200 pounds. The motor is controlled by a **Cutler-Hammer** rheostat which will shut the pump down to 10 per cent. of the feed when the pressure in the tank reaches the maximum.

Two open water tanks are installed near the pumps. One tank receives the waste water from the elevators and the pump suction is connected to the second tank. The arrangement prevents surging in the suction tanks and air from being carried over to the pumps.

Refrigerating Plant, Etc.

The main refrigerating plant is located in the engine room, and consists of a **York** 9 in. x 9 in. single acting vertical enclosed type, 20-ton ammonia compressor, direct connected to a vertical, simple engine, using super-heated steam. The combined brine storage and ice freezing tank is 20 ft. x 8 ft. x 5 ft. deep, divided in two compartments, by means of a bulkhead running lengthwise. This is in order that a lower temperature can be carried in the ice freezing compartment than in the brine and cooling compartment.

WILLIAM DUTTON.
Chief Engineer.

The freezing compartment has capacity for making 1½ tons ice, part in 50 pound cans and the balance in 100 pound cans. The brine coolers, which are standard **York** double pipe counter current type, are of thirty tons capacity, and are submerged in the brine compartment of tank

The 7-8-10 in. simplex steam driven brine circulating pump is of the Bawden Machine Co. make, and also has capacity of thirty tons. The large capacity of brine tank, brine coolers and pump is to allow for installing a future 12-ton machine if same shall be required.

There are about 1,800 feet of brine circulating mains, all made up with ammonia fittings, and covered with **Nonpareil** moulded cork covering. These mains distribute the brine to the three kitchen boxes on the sixth floor, to the fur storage room on the third floor, and to the five refrigerator boxes in the grocery department in the basement. Outlets in brine mains have been made for connecting to drinking water cooling tank, for the drinking water system which is installed.

The fur storage is located on the third floor and is 43 ft. x 14 ft. x 15 ft. high, with an ante room. The room is insulated with 4 in., H. W. Johns-Manville pure corkboard applied in two layers and finished with **Keen** cement. The room is cooled by means of brine circulating coils arranged along the wall, with all suitable drip pans and guards. The piping is made up with ammonia fittings. There are four sets of fur racks, double decked, so that practically all the space is utilized for storing furs, except what is required for two narrow passage ways. The plant complete was furnished and installed by the Canadian Ice Machine Co., Toronto.

* * *

STATIONARY ENGINEERS CONVENTION CALLED OFF.

THE big convention of stationary engineers which was to have been held in Regina during fair week has been called off, on account of difficulties experienced in connection with the exhibits. It had been planned to use all of the space under the grand stand for the exhibition of stationary engines, boilers and machine parts, but as the date drew near it became apparent to the central committee that a number of the exhibitors were going to fall down, partly because of the long distances which the exhibits had to be brought and partly because of previous engagements made by exhibitors for displaying their goods at other fairs throughout the Dominion, so notices were sent out calling the convention off for this year at least.

Mr. Fox, the engineer at the Normal School, and a member of the central committee, states that over 2,700 delegates had signed up to attend the convention before the scheme was abandoned, and prospects were bright for an exceedingly interesting and profitable time.

Safety Provisions Relative to Transmission Machinery--III.

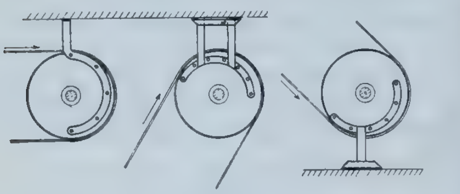
By W. Sydney Smith

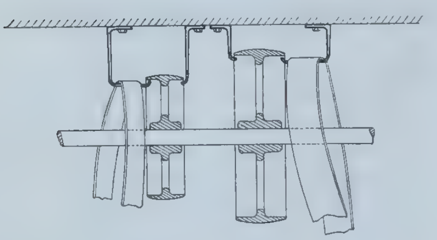
An official report by the Inspector for Dangerous Trades in England, regarding fencing and safety precautions for transmission machinery, has been issued. It explains the structural and administrative safeguards with regard to the several parts of transmission machinery which experience shows to be needed for the protection of persons employed.

THE introductory portion of the present article is a continuation of the **Belt-Perch feature,** and starts off by stating that the design of the bracket (Fig. 18, July issue) can easily be adapted to suit different positions and directions of the driving belts (Fig. 19).

If a pulley be situated close to a bearing, or if two pulleys are close together, modified perches (Figs. 20 and 21) should be fixed to prevent the belt falling between pulley and bearing or between the pulleys,—a frequent cause of accidents and damage to mill-gearing and machinery.

Some form of belt-perch should be used in preference to tying up a belt to the ceiling above the shafting, an operation which often has placed the worker in a position near unfenced shafting, and in many instances has led to fatalities and serious injuries. Whenever any belt repairs are necessary while the shafting is in motion, the belt should never be allowed to come in contact with the shaft, but should rest either on the sleeve fencing the shaft, or on a belt-perch. Portable perches consisting of an inverted trough fixed to the end of a belt-pole are sometimes used, but fixed perches are more satisfactory whenever these are practicable.





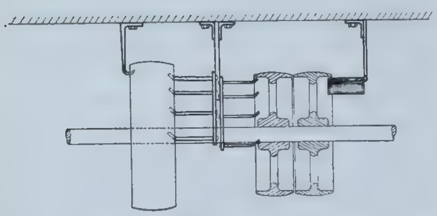


FIG. 19. PERCHES FOR DIFFERENT BELT POSITIONS.
FIG. 20. SIMPLE BELT PERCHES.
FIG. 21. TYPES OF BELT PERCHES.

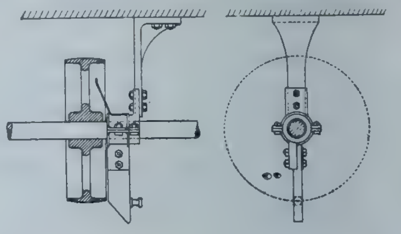
Belt Shippers.

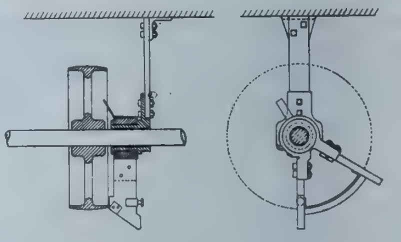
A number of appliances, both portable and fixed, have been designed for replacing belts on pulleys from the floor level. For belts not exceeding three inches wide, an ordinary belt-pole may be used, this being a strong, light pole about 1½ inches diameter, carrying at its upper end a wrought-iron pin at right angles to the axis of the pole. The length of the pole should not be less than the height of the shafting above the floor level, there being risk of accident with a short pole as the lower end is liable to be driven forcibly towards the workman. A rigid belt-pole is unsuitable in many cases, and its use may be considerably limited by position, size, length, tension, or direction of the belts, or by obstructions such as pillars, beams and walls. Various types of jointed and flexible belt-poles have been devised to overcome these difficulties; a flexible pole being probably safer to handle than one of the rigid type. When the belts are too heavy or the shafting too high to allow the use of a belt-pole, mechanical belt-shippers enable the belt to be replaced on the driving pulleys from the floor level with perfect safety, without stopping or slowing the transmission machinery.

The earliest type was invented by M. Boudoin, of St. Sauveur-Luxeuil, in 1871, and is said to be in general use throughout the factories in Alsace. This (Fig. 22) consists of an arm or board with beveled edge bolted to a socket which is free to rotate on a fixed sleeve encircling the driving shaft. This sleeve is attached by a bracket to some convenient support adjacent to the pulley. Both socket and sleeve are made in halves screwed together. The fit between sleeve and socket may be adjusted by tightening or slackening the socket screws. The driving shaft rotates freely within the sleeve. The appliance thus forms a belt-perch upon which the belt rests when thrown off the driving pulley, and each pulley must be fitted with one of these appliances. To replace a belt, the wooden arm and socket are turned through an arc of a circle by means of a pole fitted with a hook which engages a small knob near the lower end of the arm; the beveled edge of the arm picks up the belt, allows it to slide on the pulley at the point of intake, and prevents it slipping off the pulley as it travels round the rim.

The type of belt-shipper adopted by the Italian Association for Prevention of Industrial Accidents closely resembles the above, but the lower half of the socket is provided with two arms inclined at an angle of 60 degs. towards each other and connected at the beveled extremities by a metal band bent to the same curvature as the pulley rim. (Fig. 23.)

There is also a portable Boudoin belt-shipper which may be used for shafts and pulleys varying somewhat in diameter, as shown in Fig. 24. The apparatus is placed adjacent to the pulley and held in position while the belt is replaced in the usual manner by rotating the arms with a hook attached to a pole.





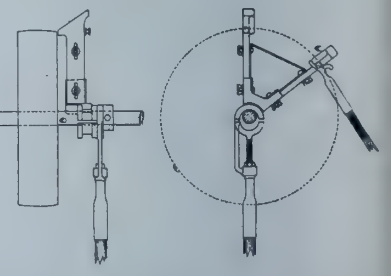


FIG. 22. BELT SHIPPER (BOUDOIN TYPE).
FIG. 23. BELT SHIPPER (ITALIAN TYPE).
FIG. 24. PORTABLE BOUDOIN BELT SHIPPER.

The Brancher belt-shipper (Fig. 25), is similar to that of Boudoin, but the supporting bracket and sleeve are omitted; the socket carrying the wooden arm is suspended on the line close to the pulley, and lateral movement is prevented by a pair of collars screwed to the shaft by counter-sunk screws. The Brancher apparatus and other types may be actuated by means of cords or hand-chains instead of a pole if a light pulley with a v-shaped rim is attached to the socket carrying the belt-shipping arm.

A number of other types have been devised by Continental inventors, and these consist of various arrangements of metal arms adjoining the pulley, and form a belt-perch which carries the unshipped belts. The arms are generally rotated by means of hand chains or cords. An English type of belt-shipper is shown in Fig. 26.

Immediate Stoppage of Transmission Machinery.

Provision should be made in all factories for bringing the shafting quickly to rest in case of breakdown or accidents to workers from transmission machinery. In old installations, electric bells are often considered sufficient for signaling, but these are generally inadequate in case of mishap or accident. Where steam engines are used, more efficient devices are those whereby the engine stop-valve can be directly actuated from any floor or room in a factory, by means of electric push-buttons fixed in a convenient position.

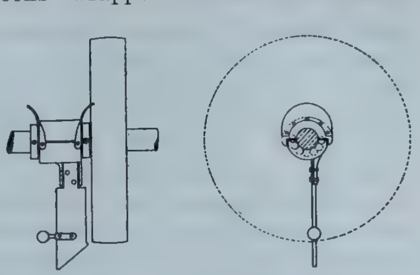
With electric motors for driving the main shafting, it is comparatively easy to arrange in convenient positions, push-buttons to actuate the main switch and stop the motor. A powerful electro-magnetic block brake may also be fitted on the line shaft to bring the transmission machinery quickly to rest. If mechanical appliances such as clutches be used, the means for disengaging the transmission machinery should be within convenient reach of the workers.

Oiling and Cleaning.

Such necessary work as oiling and cleaning should be done only by trained and authorized persons; and the oiling of shafting only during stoppage of the transmission machinery, or (if this is not possible owing to special circumstances or the requirements of the manufacturing process) during slow running of the line shafts, unless the transmission machinery is so fenced as to prevent accidental contact with moving parts. Oil cups or lubricators should be fitted on all shaft bearings unless these are of a self-lubricating type. In self-lubricating bearings, the supply of oil or grease will last for weeks or months with little attention, and hence the risk of accident to engineers and greasers is reduced to a minimum.

Lubrication of loose pulleys is not always easy, and if a loose pulley seizes a shaft from want of oil, the machinery may unexpectedly be set in motion and accidents result. The loose pulley is sometimes made slightly less in diameter than the fast pulley in order to lessen the belt tension. Needle lubricators and lubricators of the Stauffer type, or those fitted with a piston and filled with solid grease, are sometimes used. The pulley may ride on a recessed sleeve, secured to the shaft, and be filled with solid lubricant which can reach the inner revolving surface of the pulley boss through holes in the sleeve.

Cleaning and polishing of shafting in motion should never be done with cotton waste, rags or emery cloth held in the hand. Proper appliances should be used, such as long-handled brushes, hooks wrapped round with cord or special clamps with the jaws covered with leather or emery cloth. These can generally be manipulated from the floor level. Rings of metal or leather which hang loosely on the shaft are to be found in some factories. These travel to and fro along the shaft and effectually clean it. They are largely adopted abroad. Many accidents occur between belts and pulleys in motion to workers engaged in treating belts with various compositions to keep them pliant, or in applying resin to slack belts to make them grip the pulleys better. This is a dangerous practice which should not be allowed, unless the transmission machinery is stopped or moved slowly. With a shaft speed of not more than five revolutions per minute, there should be little danger.



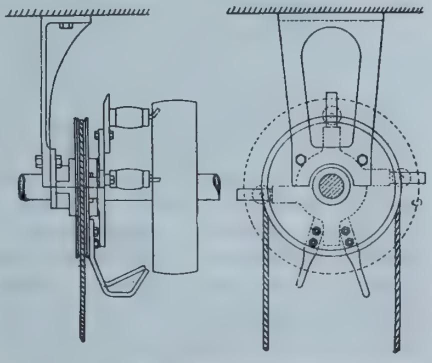


FIG. 25. BELT SHIPPER (BRANCHER TYPE).
FIG. 26. SAFETY BELT SHIPPER (COWLEY'S PATENT).

Ladders for Transmission Machinery.

Suitable non-skid devices are necessary for all ladders used in factories, especially in connection with transmission machinery for manipulating belts, oiling bearings, and other work of maintenance. Shafting ladders are generally fitted with hooks at the upper end, large enough to rest on the shafts. The hooks should be bound with cord.

Many appliances have been devised for preventing slipping at the ladder foot. Iron spikes attached to the bottom of the ladder are common, but these are dangerous where persons are accustomed to work with bare feet. Generally speaking, the form and material of the non-skid device should depend on the kind of floor, iron-shod feet being unsuitable for hard floors such as iron plates, flagstones, brick, tiles, or concrete unless the surface be grooved; in such cases, leather or india-rubber is more satisfactory, though unsuitable for greasy floors. Iron spikes, except as above mentioned, or cast-iron swivel shoes, can be used on soft floors such as wood. Where a ladder is required to be reared at different inclinations, swivel feet are the most satisfactory.

MANAGER AND CHIEF ENGINEER RELATIONSHIP.

IN my opinion, said O. E. Morris, addressing the Practical Refrigerating Engineer's convention, there is not a subject pertaining to, and directly influencing the success or failure of ice and refrigerating plants which is more vital than co-operation between the men responsible for the management of the different departments. Unity of purpose and understanding between manager and chief engineer of refrigerating plants is as necessary to success as the demand that made the plant itself a necessity.

The magnitude of the refrigerating business can only be appreciated by those who keep themselves informed and in touch with its rapid advancement. The field for more efficient men is becoming evident more and more every day, and the time is not far distant when the the demand for efficient and trustworthy men will far exceed the supply. Engineers must advance with the age. Larger things are coming, and men must be larger to meet them.

Co-operation is not only necessary to good business results but also to the broadening of our minds. For example, to make way for what we build to-day we must tear down to-day what we built yesterday. The old is giving place to the new—and the new of to-day is the old of to-morrow. There was never greater need for general co-operation than now. Every phase of life has its own line of advancement, great or small, and there never was a time or condition that justified a narrow selfishness.

Boiler Room Efficiency and Task Setting for Firemen*

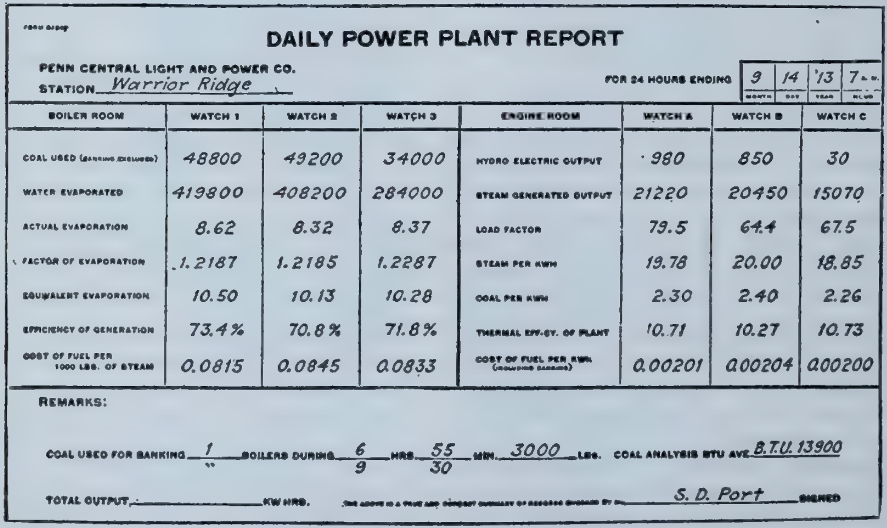
By Walter N. Polakov

The object of the accompanying paper is to outline a method for the accurate determination and permanent attainment of maximum economy in daily boiler-room practice by the task-setting method. The problem involves a knowledge of the conditions under which maximum operating economy can be obtained and the determination of the factors which wlil secure the permanency of these best conditions.

FREQUENCY OF FIRING.

THE next information important for the fireman is the frequency at which his furnace must be coaled to keep the fires in best condition. The method adopted by the Italian Navy is accepted by the writer as most satisfactory, consisting chiefly in bell signaling at intervals in proportion to the load carried by the boilers, which signaling is regulated by clock mechanism connected with a flow meter. For use in a boiler house where a number of batteries are fired independently, a modification of this method was devised to equalize the driving of each furnace. For this purpose the counter of the feedwater weigher, supplying water to the entire boiler house, rings the bell every time a certain number of thousand pounds of water is fed to the boilers, thus giving notice to the firemen that an adequate number of shovelfuls must be thrown into each furnace. This number is easily determined since the weight of a shovelful of coal is known and the rate of apparent evaporation at the given condition of firing is a constant.

In a public utility plant the load carried by the boilers varies considerably, as a rule, not only throughout a day but often within an hour, in which it may swing from maximum to minimum, or vice versa. While with a number of small steam generating units the peak periods and off-peak valleys in the load curve do not affect the rate of driving individual boilers since the number of boilers put into service can easily be changed, a widely fluctuating load within a short period has its limiting influence on the attainable efficiency of steam generation.



DAILY POWER PLANT REPORT

PENN CENTRAL LIGHT AND POWER CO.

STATION *Warrior Ridge*

FOR 24 HOURS ENDING 9 (MONTH) 14 (DAY) '13 (YEAR) 7 A.M. (HOUR)

BOILER ROOM	WATCH 1	WATCH 2	WATCH 3	ENGINE ROOM	WATCH A	WATCH B	WATCH C
COAL USED (BANKING EXCLUDED)	48800	49200	34000	HYDRO ELECTRIC OUTPUT	980	850	30
WATER EVAPORATED	419800	408200	284000	STEAM GENERATED OUTPUT	21220	20450	15070
ACTUAL EVAPORATION	8.62	8.32	8.37	LOAD FACTOR	79.5	64.4	67.5
FACTOR OF EVAPORATION	1.2187	1.2185	1.2287	STEAM PER KWH	19.78	20.00	18.85
EQUIVALENT EVAPORATION	10.50	10.13	10.28	COAL PER KWH	2.30	2.40	2.26
EFFICIENCY OF GENERATION	73.4%	70.8%	71.8%	THERMAL EFF.CY. OF PLANT	10.71	10.27	10.73
COST OF FUEL PER 1000 LBS. OF STEAM	0.0815	0.0845	0.0833	COST OF FUEL PER KWH (INCLUDING BANKING)	0.00201	0.00204	0.00200

REMARKS:

COAL USED FOR BANKING *1* / *"* BOILERS DURING *6* / *9* HRS. *55* / *30* MIN. *3000* LBS. COAL ANALYSIS BTU AVE. *B.T.U. 13900*

TOTAL OUTPUT, ______ KW HRS.

S. D. Port SIGNED

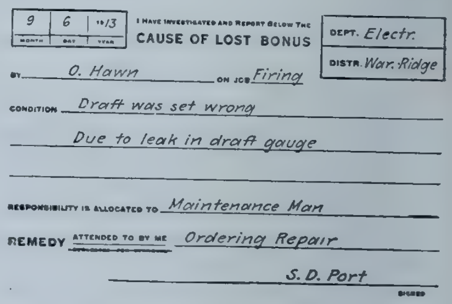
FIG. 4. DAILY REPORT FROM THE PLANT, SHOWING AVERAGE RESULTS.

Time Element in Boiler Performance.

The time element in boiler performance, or, in other words, the time required for generation of a certain quantity of steam with the greatest economy, is of utmost importance.

Here again we are confronted with the fact that the thermal efficiency is not a final criterion and it is often the case that high rate of driving, although thermally efficient, is too expensive on account of special costly devices necessary for forcing the boilers or uneven distribution of work on the men, requiring extra men idle part of the time. Unwarranted fixed charges in one case and a high pay roll in the other make it financially desirable to limit the output of the boilers. Again, in other cases low rates of driving are abandoned irrespective of the thermodynamic advantages on the strength of financial impossibility for the concern to add new units.

The above considerations require for proper solution of the problem a scrupulous research into interdependence of: (a) Variation of fixed charges with various time units required for production of a unit of volume energy in shape of steam; (b) variations of thermal efficiency with the variations of the above time unit; (c) variations of pay roll, etc.; (d) variations of the cost of maintenance, etc.; (e) physical limits affecting the quality of steam, as size of superheaters which at certain point are unable to absorb the heat due to slow convection of heat by dry steam; and (f) physical limits of space. Thus, while the increase of output up to certain limit usually increases the thermal efficiency, after this point it begins to fall. It is in most cases erroneous to assume this maximum efficiency point as a best load at which to operate the boilers, due to the complexity of the above mentioned limiting factors.



9 (MONTH) *6* (DAY) *'13* (YEAR)

I HAVE INVESTIGATED AND REPORT BELOW THE CAUSE OF LOST BONUS

DEPT. *Electr.*

DISTR. *War. Ridge*

BY *O. Hawn* ON JOB *Firing*

CONDITION *Draft was set wrong*

Due to leak in draft gauge

RESPONSIBILITY IS ALLOCATED TO *Maintenance Man*

REMEDY ATTENDED TO BY ME *Ordering Repair*

S. D. Port SIGNED

FIG. 5. CAUSE RECORD OF LOST BONUS.

Determining Task Scope.

In setting a task for firemen, it remains to be determined what the scope of the task shall be. In order to accomplish the purpose it devolves upon the management to accumulate the detailed and exact knowledge of the most favorable conditions to attain results and make it possible and desirable for every employee to live up to them. It is for the employee, on the other hand, either to create or maintain such conditions as are required in the management's specific instructions. Various schemes have been used as the basis of task setting for firemen which to the writer's knowledge have always created dissatisfaction. Certain of these are as follows:

1.—The cost of steam generated was used for the basis of the task in the boiler room of a large cement plant, and a premium offered for the reduction of this cost, but as firemen have no control over the purchase of fuel, maintenance of equipment, etc., this task involved the standardizing of conditions of combustion, for which no instruments were provided and no definite standard or aim was set before them, and the scheme was soon abandoned.

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*Part II. of a paper read recently before the American Society of Mechanical Engineers.

2.—The high percentage of CO_2 in flue gas was adopted as a task basis for firemen in several plants, but the men were not trained nor were they even shown how to obtain it. When they occasionally attained the mark, the question remained undecided whether high percentage of carbon dioxide was coincident with the most economical steam generation or not, and the method proved generally unsatisfactory.

3.—A high percentage of CO_2 and low percentage of combustible in the ashes, were factors upon which another attempt was made to specify more definitely the firemen's task. The question remains, however, whether the conditions which the firemen must observe to attain the task and produce gas rich in carbon dioxide and an ash with little carbon, are actually the best for transmitting the heat of the gases to the water and steam and whether at any load the same standard is equally beneficial.

4.—A limit on coal consumption as a task for railroad firemen was favored at one time. This idea, probably the most ridiculous and illogical, soon demonstrated its own weakness and has been almost entirely abandoned.

The lack of analytic thought in these instances is remarkable; such important factors as condition of equipment, variable quality of fuel, weather conditions, necessary instruments, complete record keeping, thorough instructions, etc., were disregarded or undervalued. The common cause of failure of such schemes has been the desire to make a short cut and jump over all preliminary studies, and save the time and trouble of training men in a systematic and thorough manner how to accomplish the task set for them. Should such training be undertaken with bona-fide intentions, the instructors themselves would be compelled to discontinue the training as soon as they discovered that the control of the conditions affecting the results is beyond the men.

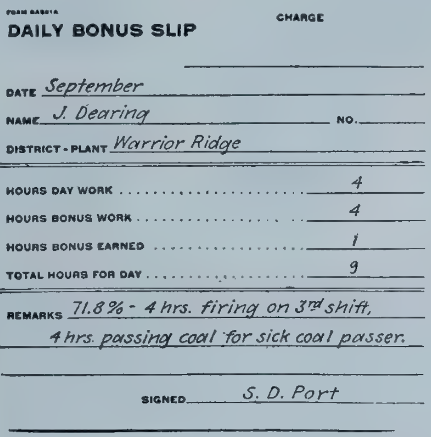
Measuring Effect of Task Accomplishment.

The question of measuring the effect of task accomplishment can be approached from either end, but it is more convenient to figure out the result, and if this is below the standard, turn to the records of conditions and there locate the discrepancy between the required results and those obtained. A gauge for measurement of the degree of fulfilment of task conditions set is offered by the factor of thermal efficiency of grate, furnace and boiler which is

$$\frac{\text{heat transferred to steam}}{\text{heat available in fuel}}$$

This measurement involves several corrections for factors beyond fireman's control and neither ratio of apparent evaporation nor boiler efficiency nor efficiency of combustion alone are anywhere near sufficient for the purpose of judging the efficiency of the work of men.

Actually to calculate the efficiency of the boiler, furnace and grate is a tedious and comparatively long procedure, and is never made in power plants for a day, shift, fireman or gang of fireman working in team. The writer in his capacity of consulting engineer devised and introduced a comparatively simple method of obtaining a complete record of firemen's performance and to figure their efficiency. This method, which has been in vogue for over a year at the central station at Warrior Ridge, Pa., requires the following record data:



DAILY BONUS SLIP CHARGE

DATE September

NAME J. Dearing NO.

DISTRICT - PLANT Warrior Ridge

HOURS DAY WORK 4

HOURS BONUS WORK 4

HOURS BONUS EARNED 1

TOTAL HOURS FOR DAY 9

REMARKS 71.8% - 4 hrs. firing on 3rd shift, 4 hrs. passing coal for sick coal passer.

SIGNED S. D. Port

FIG. 6. FIREMEN'S DAILY BONUS SLIP.

1.—Coal records from store issue tickets and coal passers reports compiled every eight hours.

2.—Heat value of fuel determined by bomb calorimeter and value of coal in B.t.u. known for each coal pocket.

3.—Amount of water fed to boiler (banked boilers fed separately) ascertained for the same periods.

4.—Temperature of feedwater recorded.

5.—Steam pressure recorded.

6.—Degrees of superheat recorded.

These data are turned over to the station clerk who proceeds as follows:—

(a)—From the slide rule shown in Fig. 2, he ascertains the factor of evaporation (corrected) on the basis of absolute boiler pressure, temperature of feed and temperature of superheat.

(b)—By means of the power plant log calculator, Fig. 3, he determines:—

1.—Actual evaporation ratio during each watch or per each man.

2.—Factor of evaporation during each watch or per each man.

3.—Equivalent evaporation during each watch or per each man.

4.—Efficiency of steam generation per watch or per each man.

5.—Cost of fuel per 1,000 lb. of steam per watch or per each man.

He then enters the results of computation on the daily power plant report form, Fig. 4. The whole procedure takes on the average 18 minutes of the clerk's time, for whom, incidentally a specific task is assigned and sufficient hourly bonus offered for, its fulfilment.

Every case of failure on the part of any fireman to secure on his watch the combined boiler, furnace and grate efficiency of 70 per cent. or above is immediately investigated by studies of other records and recording charts of draft, temperature of escaping gases, nature of boiler refuse, etc., and if no reason can be found there, an examination of the physical condition of equipment and apparatus is made. The result of this investigation is recorded on a form for cause of lost bonus, Fig. 5.

This method is particularly valuable and outside of its direct advantages provides an aditional and continuous training of the men in careful observation of harmful factors of the slightest nature. Then, by means of complete and trustworthy records, the firemen are informed as to results of their work before they come back for the next watch, see Fig. 6, and moreover, while they are proceeding with their work, they have in addition to previously mentioned instruments indicating the condition of firing, continuous information as to results they are accomplishing up to any moment of their watch. This is accomplished by having coal weighing and water metering so balanced that an even number of dumps of feedwater and dumps of coal indicates that the ratio of evaporation, superheat, pressure and feed temperature being as specified is on the safe side of the requirement.

* * *

High Boiler Capacity.—During the month of May a nine-hour test was made at the Oliver Hotel, South Bend, Ind., on a 150 horse-power Babcock & Wilcox boiler equipped with a Nicholson furnace. In addition to the regular hotel load, the engine was put into service from eight to nine a.m., and from two to three p.m., to determine both the overload that could be carried on the boilers, and whether this overload could be handled until another boiler was thrown into service. The boiler developed 309 horse-power during the peak of the morning, which is 206 per cent. of the rated capacity. Thirty-eight pounds of coke breeze per sq. foot of grate surface per hour were burned. Abundance of air, it is claimed, made possible the use of this coke breeze. The air supply was furnished by an 18 in. turbo-undergrate blower, built by the B. F. Sturtevant Co. of Canada, Galt, Ont.

Results of Neglected Leakage from Boiler Joints, Etc --IV.

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

CRACKS DUE TO EFFECTS OF DEFLECTION.

IN the previous articles, which appeared in our May, June and July issues, the feature of corrosion arising from miscellaneous leakages and that due to expansion cracks was treated at length. In the present instance, corrosion and other troubles arising from cracks due to the effects of deflection are dealt with.

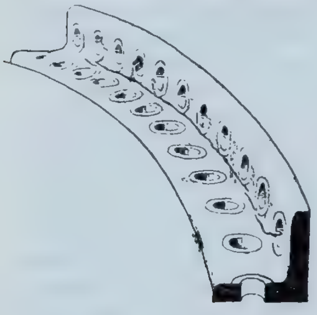


FIG. 42.

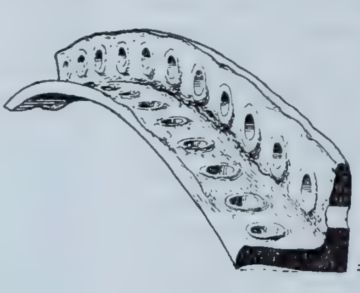


FIG. 43.

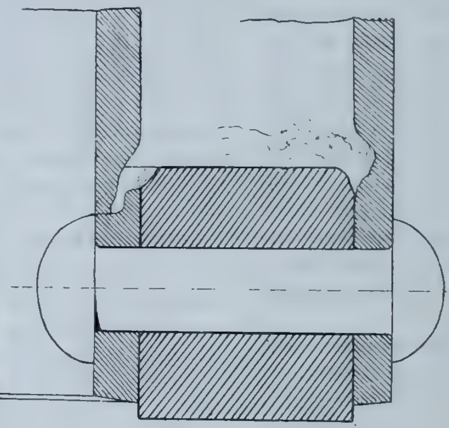


FIG. 44.

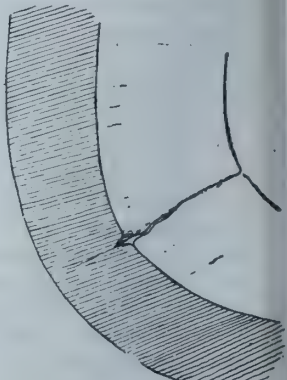


FIG. 45.

Fig. 42 belongs to a boiler with two internal furnaces, being a piece of the angle iron attaching the right furnace to the furnace front. Over a length of about 400 m.m. the angle iron presents a fine crack very little open. The angle iron is cracked right through for a length of 250 m.m.

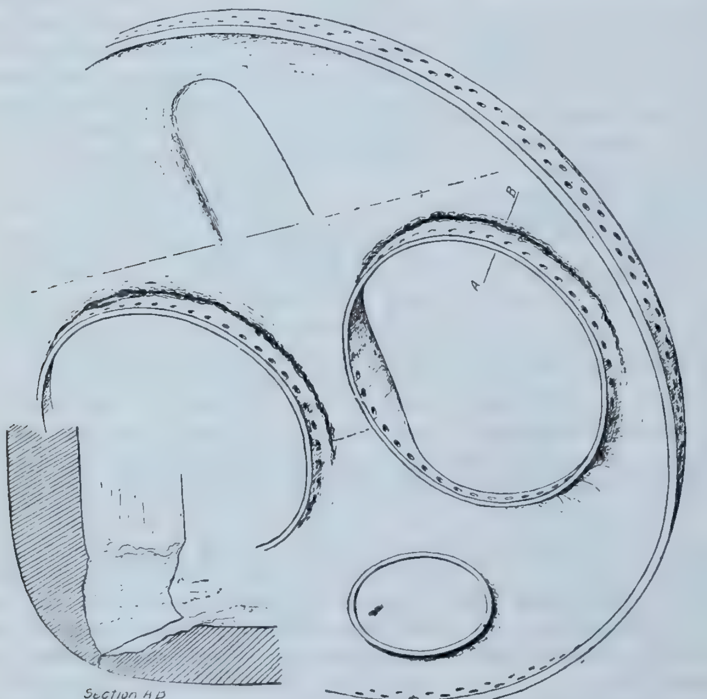


FIG. 46.

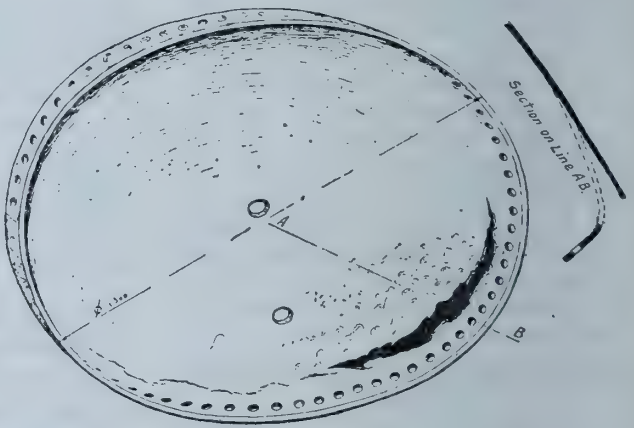


FIG. 47.

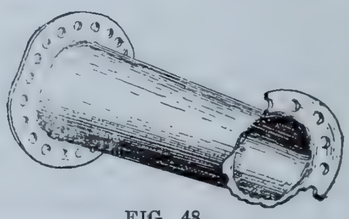


FIG. 48.

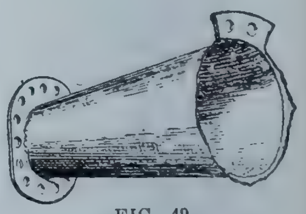


FIG. 49.

Fig. 43 is from a boiler with two internal furnaces, being a piece of the angle iron attaching one of the furnaces to the front end. At the angle over a space of 350 m.m. there is a crack enlarged by corrosion which runs all along the iron. The latter is further deeply corroded. The corrosion is in the form of pitting which is practically continuous.

Fig. 44 shows corrosion of the furnace plate at the level of the foundation ring in a vertical boiler with Field tubes.

In the case of a boiler similar to the preceding, there showed corrosion of the shell plate at the level of the foundation ring. At one point this corrosion extends through the entire thickness of the plate.

Fig. 45 is a piece of a dished end of a boiler with two internal furnaces, At the curvature of the outward flanging for the furnaces on both sides and upwards there are grooves of corrosion presenting the form of small parallel discontinuous cracks apparently of very slight depth. The boilers were made in 1899 and the defect was noticed for the first time in 1901. Its development since seemed of little importance. The external appearance was scarcely altered. In 1910 it was observed that one of the ends was cracked through at one point. In cutting out a piece it was seen that there existed a very fine crack running through practically the entire thickness of the end. The replacement of the front end plates of the whole battery of boilers was at once recognized as being necessary.

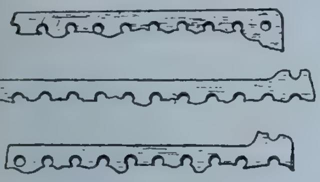


FIG. 50.

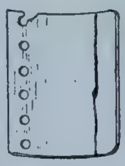


FIG. 51.

Fig. 46 shows pieces of the front end plate of a boiler with internal furnaces. At the curvature of the outward flanging for the furnaces on the sides and upwards, and in the flanging of the end plate on the sides, there are wide and deep grooves of corrosion, the importance of which is greatest above the furnaces where their depth reaches 20 to 25 m.m. The groove is considerably enlarged by corrosion. The boilers were made in 1898. Owing to the use of certain condensed steam, grease found its way into the boilers along with the feed water. Overheating resulting from the grease has caused deformation of the furnaces, and abnormal expansion the cracks in the end plates. This corrosion commenced to show itself in 1903 and grew very rapidly until 1904, the year when the introduction of grease was stopped. Since that time its growth was very slow, it being in 1910 that one of the front end plates became cracked through.

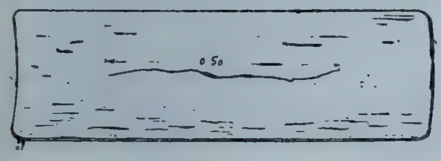


FIG. 53.

Fig. 47 belongs to the bottom plate of the reservoir of a multitubular boiler. At the flanging of the bottom part of the plate for about one-third of the circumference there is a series of small hair cracks not quite continuous and apparently of very slight depth. This plate gave way at the cracked part. Examination of the fractures showed that at certain parts the cracks extended through the entire thickness of the plate. The bottom of the plate further showed corrosion which is accentuated by pitting.

Fig. 48 is a Galloway tube. The upper flange is fractured all round the circumference and the lower for two-thirds. At the prolongation of the fractures, cracks both superficial and otherwise were noticed. The appearance of the fractures seems to indicate that the metal was very brittle.

Fig 49 refers to another Galloway tube, the upper flange of which is fractured at the beginning of the curvature for near the whole of the circumference.

Fig. 50 belongs to an elephant boiler with two drums, there being a crack in the line of rivets of a longitudinal seam. The crack is due to the deflections that the seam has had to bear. It is likely enough that the metal was of bad quality or at least rendered brittle by the work which was done on it in riveting together the plates. The edge of the plate shows traces of numerous and severe caulkings which have caused the plate to bend.

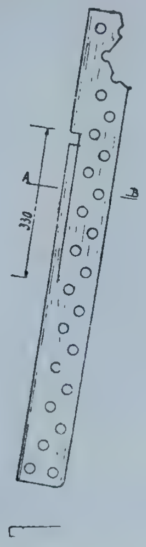


FIG. 52.

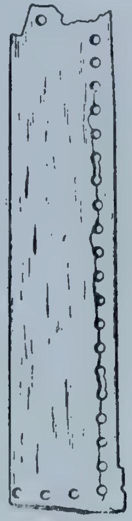


FIG. 55.

Fig. 51 is a crack in the solid plate near a longitudinal seam of one of the drums in an elephant boiler with three drums, not suspended and covered with very thick brickwork. After some years the drums became distorted in places into an oval form.

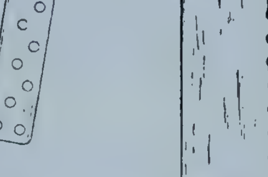


FIG. 54.

Fig. 52 shows a crack in the solid plate along the line of caulking of a longitudinal seam in a locomotive boiler. The original cause of the crack is probably bad caulking.

Fig. 53 shows a crack in the solid plate of a drum of an elephant boiler with four drums, which occurred when the boiler was being moved. The bottom of the drum shows a flat place, and the crack is at the beginning of the distorted flattened part.

Fig. 54 refers to a crack in the solid steel plate of a drum. The crack commences at the edge of the plate, crosses a rivet hole and a little past the latter divides into two.

Fig. 55 shows a crack in a longitudinal seam of a boiler shell.

WILL OIL REPLACE COAL AS FUEL?

By W. J. Dick.

THE world's production of crude petroleum in 1912 amounted to about 52,921,750 tons; the sources, respective quantities and percentages were as follows:

Country.	Net Tons.
United States	32,897,060
Russia	10,174,560
Mexico	2,910,000
Roumania	1,987,360
Dutch East Indies......	1,672,000
Galicia	1,298,620
India	1,101,450
Canada	38,750
Other countries	841,250

If the whole of this crude petroleum were employed as fuel in steam-raising it would not replace, allowing for its higher thermal efficiency, much more than 5½ per cent. of the world's output of coal, whilst if used in internal combustion engines it would be equivalent, as a source of power, to about 16 per cent. of the coal. Only a small proportion, however, of the crude petroleum can be regarded as available for use as a source of power, for by far the larger part is in demand as an illuminating agent and as a lubricant for machinery.

As the United States produces over 62 per cent. of the world's production of petroleum, it is interesting to note that Dr. Day, of the United States Geological Survey, considers that, at the present rate of increase of the output of petroleum, the known oilfields of the United States will, on the basis of the minimum quantity of oil obtainable, be exhausted by the year 1935, while, even if only the present output were maintained, the supply would, on the same basis, not last more than nineteen years.

In many countries there are, no doubt, vast tracts of undeveloped petroliferous territory, but only drilling can determine this. Even if the available deposits were far larger than there is reason to believe them to be, the cost of doubling the present output would be great. In view of these circumstances, it is not probable that there can be any general substitution of petroleum for coal as a source of power, although there is undoubtedly opportunity for making provision for a large use of liquid fuel for certain purposes in which its advantages are conspicuous.

C.A.S.E. Annual Convention and Exhibition at Ottawa, Ont.

Staff Report

The opportunities for engineers to mix with their fellow operatives are in the nature of things somewhat limited, even although in the larger manufacturing centres their numbers are sufficient to permit of their banding together for mutual help and improvement. A double function such as is here described, makes possible even in a limited period to all, isolated or otherwise, an increased enthusiasm for their calling, a holiday amid pleasant surroundings, and tends to a closer intimacy with developments in the specialties of those who cater to power plant needs.

THE Twenty-fifth Annual Convention of the Canadian Association of Stationary Engineers was held at Ottawa on July 28, 29 and 30. It was generally conceded that this was the most successful gathering of the many hitherto held, and furthermore, the weather was ideal. The officers of Ottawa Lodge C.A.S.E. are to be congratulated on the able way in which the arrangements were carried out, while G. C. Keith was as usual the mainspring of the Exhibitors' Association. A. Kastella and George Lee, the convention local president and secretary respectively, as individuals merit special mention for the large part they played in making the function so deservedly popular.

Convention Headquarters.

The meetings of the C.A.S.E. were held in the Ottawa Amateur Athletic Association Building on Elgin Street, and were attended by delegates from the various lodges in Ontario, including a delegation from Montreal headed by W. A. Sackett. In the same building, the Exhibitors' Association had their display of power plant specialties arranged, the room being tastefully decorated with flags, etc. Practically all the available space was taken up.

Convention Opening And Banquet.

The opening session of the convention was held on the afternoon of Tuesday, July 29, and in the evening the annual banquet, given by the Capital City Lodge, was held in the New Russell Hotel. The banquet was presided over by A. Kastella in an able manner, while considerable interest was imparted to the proceeding by the presence of several distinguished guests, among whom were the Mayor of Ottawa (Mr. McVeity), Controller Hector MacLean, ex-Mayor Hopewell, Mr. Griffiths, and Jack Armour, of **Power**, New York.

After a most enjoyable, because well prepared, supper, speech-making opened with an address by the chairman. Mayor McVeity responded to the toast of "The City of Ottawa," and after welcoming the delegates, exhibitors and guests, hoped that they would meet again in Ottawa. He hoped they would uphold their name of stationary engineers by remaining in the room until the conclusion of the programme. Several appropriate speeches were delivered during the evening, while the musical portion was capably taken care of by Messrs. Hetherington, Fiddes and Neville. Jack Armour twice took the floor and with his inimitable style and fund of humorous anecdotes dispersed every semblance of or tendency to dullness in the proceedings. A few closing remarks by the chairman and the singing of the National Anthem brought a very pleasant and profitable evening to a close.

Exhibitors' Day.

On Wednesday morning the delegates resumed their sessions, while the afternoon was devoted to a picnic at Belle Isle Park. About 2.30 p.m. a large contingent of delegates, exhibitors and friends boarded the Ottawa River liner **Quinte Queen** and proceeded, with a band in attendance, down the river to the park. Upon arrival there arrangements were made for taking the photograph,

1, E. A. WILKINSON ON THE "DIAMOND";2, START OF THE FAT MEN'S RACE; 3, "DAD" WICKENS SURVEYING THE LANDSCAFE; 4, ARRANGING THE BALL GAME; 5, ONE END IN THE TUG-OF-WAR; 6, GOVERNMENT BUILDINGS, OTTAWA.

and during the preparations some of the heavyweights in the party, in a praiseworthy effort to get into the picture, endeavored to wreck the park furniture; the stage carpenter, however, soon put matters right. No one was seriously hurt and the photograph was duly taken, much to the relief of several married men who had been engaged in desperate attempts to curb the wandering instincts of their progeny.

ENGINEER DELEGATES, EXHIBITORS AND GUESTS, C.A.S.E. CONVENTION AT OTTAWA.

The next event of interest was the ball game between the engineers and supply men, which was won by the latter with the score 6-5. Four innings were played amidst much excitement, the games being fiercely and at times brilliantly contested. It was rumored that several senior league players were on the field in disguise, but our representative was unable to verify this.

A hundred yards dash was provided for the benefit of the light-weights, while a fat man's race was introduced for those at the other end of the scale. This race, as usual, caused much amusement, and was won in fast time by Mr. McGhie, who when in strict training tips the scale at 210 pounds; his weight at the post, however, was open to conjecture.

A field event for the ladies brought forth an interesting display of soap; this was a "**Surprise**" event. A zealous official proceeded to throw soap in all directions over the park, whereupon the ladies made wild dashes in all directions and annexed as many cakes as possible. The fortunate winner collected enough material to start a laundry.

The final event was the tug-of-war, which was won easily by the engineers, who apparently have a **lien** on this event, having proved victorious on many previous occasions. The supply men, while admitting defeat, wished that they had more **pull** with the engineers.

Reference to the band should not be omitted. The dispensers of sweet music sought the shade of a large tree, which unfortunately was some distance from the point where the Olympic games were being decided. The result was that the park menagerie, consisting of a bear, hyena, and a few natives, obtained more enjoyment from the band than the merry guests. Furthermore, triumphant marches for each winner had to be abandoned. At 6 p.m. a general alarm was sounded and a rapid move was made to the ship lying at the wharf. A pleasant sail back to the city terminated a most enjoyable and highly successful afternoon.

BANQUET TOAST LIST.

THE KING
Chairman's Address.
THE CITY OF OTTAWA
Proposed by Controller MacLean
Responded to by Mayor McVeity.
Song—Mr. Hetherington.
CANADA
Proposed by Mr. C. F. Heintzman.
Responded to by Ex-Mayor Hopewell.
Song—Mr. Fiddes.
OUR ASSOCIATION
Proposed by Mr. McGhie.
Responded to by Mr. Wickens.
Song—Mr. Neville.
Monologue—Mr. J. Armour.
OUR LEGISLATURE
Proposed by Mr. Griffiths.
Responded to by Cont. MacLean.
THE EXHIBITORS.
Proposed by Mr. Peiler.
Responded to by Mr. Wilkinson.
OUR GUESTS
Proposed by Bro. Geo. G. Lee.
Responded to by Bro. Cosford.
Monologue—Mr. J. Armour.
THE LADIES.
Proposed by Bro. Merrill.
Responded to by Bro. Thompson.
THE PRESS
Proposed by Bro. Campbell.
Responded to by Mr. B. L. Thompson.

Prize Distribution.

In the evening the delegates and exhibitors met at the Exhibition Hall and a very pleasant time was spent during the distribution of the prizes. President E. A. Wilkinson, of the Exhibitors' Association, did the honors in a highly commendable manner. At the conclusion of the ceremony, Mr. Kastella was presented with a handsome umbrella as a token of appreciation, while Mr. Geo. Lee was presented with a stick pin for his work as convention secretary.

Closing Sessions.

On Thursday morning the C.A.S.E. delegates resumed their deliberations, and the exhibitors held a meeting and elected officers for the ensuing year. In the afternoon the C.A.S.E. held their installation ceremony, and afterwards adjourning, to meet in Hamilton next summer. The Ladies' Auxiliary of the C.A.S.E. met in the morning and also elected officers.

One of the most important matters of business discussed was the question of graded certificates, a committee being appointed to wait on Hon. J. M. Duff, Minister of Agriculture for Ontario, with a view to promoting legislation in that direction.

C.A.S.E. Executive, 1914-15.

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Sports Programme and Prize Winners.

Baseball match—Supplymen.
100 yards dash—1, Galloway; 2, B. L. Thompson.
Soap race—1, Mrs. Desjardin; 2, Mrs. Kastella.
Boot race—1, Coughlan; 2, Robertson.
Ladies' 50 yards dash—1, Mrs. Dyson; 2, Mrs. Wheaton and Mrs. Coughlan (tie); 3, Mrs. Kastella.
Pie contest—Milton Kastella, Alex. Dawson, Cecil Walters.
Thread and needle race—1, Mrs. Dyson and Robertson; 2, Mrs. Walters and Galloway.
Donkey race—Barry and Coughlan.
Fat man's race—W. C. McGhie.
Tug of war—Engineers.

Exhibitors, Exhibits and Representatives.

Canadian-Allis-Chalmers, Ltd. — Domestic electric appliances, pumps.—C. R. Schragg.
Perolin Co. of Canada.—Perolin treatment of boiler scale.—F. H. Stewart.
E. Leonard & Sons—Engines and boilers.—W. F. Wheaton.
Peerless Rubber Co.—" Rainbow " and " Eclipse " packings, etc.—C. F. Heitzman, J. S. Roblin.
Can. Griscom-Russell Co.—"Stratton" steam separators and " Reilly " heaters.—E. C. Peterson.
Canuck Supply Co.—"Anchor" packings.—E. L. Foley, J. B. Robb.
Dearborn Drug & Chemical Co.—Treatment of boiler feed water.—A. W. Crouch, T. L. Beebe.
Quaker City Rubber Co.—" P. P. P." and " Ebonite " packings.—C. W. Puffer.
Imperial Oil Co.—Lubricating oils.—J. F. Cody.
Goldie & McCulloch Co.—Engines, water tube boilers and power plant equipment.—E. F. Hetherington.
Standard Sanitary Mfg. Co.—Steamfitters' supplies, Crane Co. steam specialties.—J. E. Fiddes.
Dixon Crucible Co.—Graphite boiler compound, paint and belt dressing and pencils.—L. M. Chase, L. W. Brooks.
The Boiler Repair & Grate Bar Co.—Shaking grate.—A. H. Hett.
Lunkenheimer Co.—Valves and fittings.—E. A. Wilkinson, L. Hagar.
H. L. Peiler & Co.—" Mason " and "Ashton" steam specialties, " Bawden " pump, " Cope's " feed water regulators.—H. L. Peiler, W. A. Barry.
James Morrison Brass Mfg. Co.—Brass goods, valves, gauges, loco gauges, and injectors.—A. Betton.
Garlock Packing Co.—Packings.—A. C. Pulver.
" Canadian Manufacturer "—G. C. Keith.
Cling-Surface Co.—Belting treatment.—J. B. Faatz.
V. D. Anderson Co.—Steam traps.—L. A. Rumage.
Dart Union Co.—The " Dart " line of unions.—L. M. Archibald.
Galt Foundry Co.—McNaughton grate.—F. W. Donaldson.
Jenkins Bros.—Valves.—H. A. Lomas.
" The Power House."—B. L. Thompson, A. G. Webster.

Message of Good Cheer.

Like all human institutions, the C.A.S.E. Convention and Exhibitors' Association annual meetings show gaps in the ranks of those who have been familiar figures and moving spirits in compassing the success of each gathering as it comes round. On this occasion, Howard G. Fletcher, the many years Toronto and district representative of the Garlock Packing Co., Hamilton, Ont., was an absentee, being unfortunately laid aside through illness at Gravenhurst, Ont.

During convention time word was received that Mr. Fletcher was making satisfactory progress toward recovery, and with a view to accelerating nature and his strong personality in that good work, the members of the Exhibitors' Association conspired to send him a personal lettergram, signed by each individually, expressing their sense of temporary loss experienced, and wishing him a speedy and complete recovery in health and strength, and an early return to his field of useful service.

◆

CENTRIFUGAL PUMP FOR 1,800 FT. HEAD.

IT is stated that a pump has now been in successful operation for over a year on the 1,400-ft. level of the North Star Mine at Grass Valley, California, delivering water from the sump to the surface, 1,400 feet above, at the rate of 400 gallons per minute. As the result of two careful tests conducted independently by the manufacturer and by the owner, the pump developed an efficiency of 72 per cent.

The advance of the centrifugal pump has in recent years been so rapid that, although it is now used for deep-mine pumping, elevator service, fire service, boiler feeding, and other high-head, high-duty work, there still exists among the majority the idea that it is essentially a low-head apparatus. As a matter of fact, better efficiencies may in general be obtained with high heads than with low, due to the fact that certain losses, such as energy due to velocity head, entrance and discharge losses, and bearing losses, remain largely constant, regardless of head, and are therefore a large percentage of the total energy in low head pumps than in high. Furthermore, the high pumping heads permit of the use of rotative speed apparatus, which for either electric motors or steam turbines is the condition for highest efficiency.

This North Star Mine unit consists of a ten-stage turbine-type Alberger centrifugal pump, directly connected to a 200-h.p. 2,200-vold G.E. induction motor operating at 1,800 revolutions per minute. To avoid an excessively heavy pump shaft, the pump is divided into two parts, each of five stages, connected with flexible couplings to opposite ends of the motor shaft, the discharge of the first section being connected to the suction of the second section, and the entire unit being mounted on a single cast-iron base, preventing alignment difficulties.

Proper hydraulic design of the impeller diffusion vanes and other water passages; the use of a suitable quality bronze for water passages to prevent erosion; machine grinding and polishing of water passages to minimize suction losses; the use of close clearance bushing rings to reduce water short-circuit losses; the careful hydraulic balancing to prevent thrust; the careful rotative balancing to prevent vibration; the use of long packing boxes, minimizing wear on shaft; the use of ample-sized ring oiling bearings, and the careful attention to mechanical details, are the features which have made this unit a success.

◆

Frick Co. Staff Annual Convention.—The Frick Company held its annual home office meeting of branch office managers, engineers and executives at its new offices, Waynesboro, Pa., on July 1, 2 and 3. Particular interest was attached to the meetings because of very marked improvements for manufacturing ice-making and refrigeration machinery lately developed and installed by the company. One of the features was a thorough inspection of the factory and a trial of these improved devices.

The Engineering and General Supply Co., 206 Nanton Building, Winnipeg, have been appointed agents for the Perolin Co. of Canada, Ltd.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

DESIGN AND CONSTRUCTION OF HYDRAULIC TURBINES.*

By H. B. Taylor, M.Am.S.M.E.**

SECTIONS I., II. and III. of this paper dealt with efficiency, the draft tube and runner feature, reliability, corrosion and type capacity, multi-runner type disadvantages, single runner unit advantages and installation. In the present instance the speed regulation feature relative to the governor, etc., is reviewed.

Speed Regulation—The Governor.

In addition to considerations of efficiency, deterioration and mechanical arrangements of turbines, the question of speed regulation is of great importance where turbines are employed for driving alternators. Speed regulation is obtained by means of a governor driven from the turbine shaft, consisting primarily of a governer head containing flyballs controlled by springs and connected through a pilot valve to the main governor valve. At normal speed, the flyballs hold the governor valve in its mid-position, but for any change in speed, the flyballs move the valve, admitting pressure through a suitable number of relay valves to an operating cylinder so that the turbine gates are adjusted to suit the new load and to obtain the normal speed.

Some of the chief considerations in connection with speed regulation are:—

1. Sensitiveness of the governor head involving quick response to sudden changes of speed and also response to slight changes of speed.

2. Steadiness or stability of action. This quality is an important one and involves freedom from unnecessary gate movements or movements occasioned by conditions other than changes of load on the unit. It is not only necessary for a governor to respond to changes of load, but it is equally important that it shall not act when there is no change of load. The continual motion and vibration of the turbine gate mechanism produced by unstable governors is a source of wear and rapid deterioration of the gate mechanism which in turn accentuates the lack of stability and is very objectionable. In older types of governors, this tendency was usually overcome by the use of a dashpot to damp such motions, but the use of a dashpot for this purpose renders the governor sluggish and impairs its action.

Power of Governor.

3. Power of governor. For large units, a large amount of power is required to actuate the turbine gates. This power may be obtained from a delicate governor head by the use of a series of relay valves controlled primarily by a small pilot valve attached to the governor head. In order to obtain sufficient fluid to move the operating piston, the main valve on the operating cylinder must be large and heavy; so that, with a large unit, either a considerable number of intermediate valves between the pilot valve and the main valve must be used, or else the governor head itself must be given a considerable amount of power. The same result could perhaps be accomplished by the use of high pressures in the governor system, but the use of such pressures has proved very unsatisfactory in practice and has been abandoned in favor of moderate pressures.

Since time is required for sufficient fluid to flow through each valve to move the next valve in series, increase of power by such means is limited by the speed of action required. The best solution seems to be in the use of flyballs having a weight and power corresponding in order of magnitude to the turbine which they must control. Such increase in power in the flyballs involves no sacrifice in sensitiveness, since the governor head is mechanically connected to the turbine shaft and is forced to respond immediately to any change in speed of the unit. The sensitiveness will, in fact, be increased by the use of heavy flyballs, since the retarding effect of friction can be made relatively less.

Reliability in Operation.

4. Reliability in operation. It is recognized by engineers of experience that delicate and complicated mechanisms should be avoided, and all machinery made to stand severe service and to be as nearly fool-proof as possible. For this reason, governors in important stations should be of as simple and rugged a design as possible. The effect on a large and heavy governor of accidental conditions, such as the presence of grit in the governor fluid or sticking of the governor parts, will be slight as compared with the effects on a delicate piece of apparatus.

5. The pressure system used was formerly divided into a separate pumping equipment for each unit in a station. This has been abandoned in favor of a single pumping system supplying the entire station. The change has greatly reduced the cost of attendance and has improved the continuity of service. The open system of governing is now being used in which oil or water for the governors is pumped from an open tank and no pressures less than atmosphere are used at any point in the system. This change avoids troubles caused by air collecting in the pipes or pumps or the breakdown of oil under high vacuum.

Hand Control

6. Hand control. Another recent improvement is in the nature of the hand control used for the operation of the turbine gates. Originally, the hand control of a turbine was accomplished by mechanical means through trains of gears. The mechanical efficiency of such a mechanism is so low that the time required to close the gates of a large turbine by such means is prohibitive. The mechanical hand gear was gradually replaced by a hand wheel incorporated in the design of the governor, controlling the turbine gates by oil pressure through the main valve of the governor. This arrangement, however, although it has been recently used by a number of the standard governor builders, is subject to the objection that should the governor valves be dismantled for repairs the turbine must be shut down, and it is poor engineering to dispense with the services of the turbine for the sake of a governor valve.

The best method of hand control now adopted for large units, seems to be in a separate device, entirely independent of the governor, and placed at a convenient point, and so designed as to admit oil from the central pumping system directly to the turbine operating engine. A restoring mechanism connection from the turbine gates maintains these gates in a position corresponding to the position of the handwheel. By this means it is possible to move by hand the gates of the turbine through their entire range in approximately ten seconds of time. Except for units of very large size, a small hand-operated plunger pump may be supplied in connection with the operating stand, by means of which it is possible to create pressure for the movement of the gates in the event that the central pumping system is temporarily out of service.

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*Part IV. and concluding portion of paper read before the Mechanical Section of the Canadian Society of Civil Engineers, Montreal.

**Hydraulic Engineer, the I. P. Morris Co., Philadelphia.

7. The mechanism of the modern governor itself has been reduced to a few comparatively simple operations. Certain compensating devices are required to restore the governor valves after the required gate movement has been produced and also to restore the speed of the turbine to the required value after the water columns in the penstock, turbine casing and draft tube has had time to be accelerated or retarded to its new value. The governor should also have adjustments, so that the change in speed from full load to no-load conditions may be fixed to suit the parallel operation of alternators, also to adjust the time of action of the governor to suit the length of and velocities in the water passages, and an attachment for changing the normal speed of the turbine. Modern governors are also fitted with motors by means of which the speed of the turbine can be adjusted from a distant point, such as the switchboard, this device being used in synchronizing the unit.

Speed Regulation—Other Factors.

The above points cover all the features which can be controlled in the design of the governor itself. The speed regulation of a unit, however, depends on several other factors which are invariably of greater importance than the action of the governor itself; these are the length of and velocities in the penstock and draft tube, as well as the length of the water column in the turbine casing itself; also the "flywheel effect" of the rotating masses of the generator and turbine.

A perfect governor will be unable to produce a speed regulation better than that permitted by the factors just mentioned. These factors are controlled by the design of the power development as a whole, so that the actual speed regulation obtained is only affected to a limited extent by the construction of the governor itself. Properly, all of these factors should be considered together.

In a majority of the large installations recently undertaken, turbine governors have been designed and constructed by the builders of the turbines, thus producing a governor suited to the exact conditions of each turbine and avoiding the division of responsibility which has so often proved to be a source of annoyance. The better appreciation of the factors entering into governor problems has resulted in greatly improved speed regulation which, when taken in connection with valuable improvement in the mechanical design of the governor, has removed this important auxiliary from the class of necessary evils and placed it in that of reliable machinery.

THE LATE DEAN GALBRAITH.

With the passing of Dr. John Galbraith, Dean of the Faculty of Applied Science of Toronto University, the Dominion of Canada has lost a noted educationalist, scientist and citizen. Born in 1841 at Montreal of Scotch descent, his life work has been closely identified with the growth of the Dominion. The year of Confederation was the beginning of Canada's great industrial and railway development, into which Dr. Galbraith entered as a factor upon his graduation in the following year.

THE LATE PROFESSOR JOHN GALBRAITH

He studied engineering and surveying under Geo. A. Stewart, Chief Engineer of the Midland Railway; was employed on the construction of the Intercolonial Railway and the Midland Railway extension to the Georgian Bay, and for several years was engaged on the construction of the Canadian Pacific Railroad. He, along with H. D. Lumsden, who is now chief engineer of the National Transcontinental Railway, became the division engineers of the Georgian Bay branch.

Dr. Galbraith made many trips through the wilderness of Ontario and Quebec and few were better able to equip and guide exploring parties than he. In the summer of 1881, unattended and for recreation only, he made the trip from Lake Superior via Michipicoten to Hudson's Bay, then via Rupert's River to Lake Mistassini and across the height of land to Lake St. John, reaching civilization by way of the Saguenay River.

Dr. Galbraith's academic career, though connected almost entirely with the University of Toronto, had been brilliant. Graduating from Port Hope grammar school in 1862, he went to Toronto and, finding that there was no school of engineering available, entered the university as a freshman in arts. He finished his college training in 1868 as Gold Medalist in honor mathematics and Prince's Prizeman of the University of Toronto. The Prince's Prize was a special prize for highest general proficiency, established by the Prince of Wales—Edward VII.—during his visit to Canada.

In 1878 he was appointed to the Chair of Engineering of the School of Practical Science which he largely organized himself. Dr. Galbraith was at first the only instructor, and his first class numbered less than 30 pupils. He was appointed to the principalship in 1889 and later became Dean of the Faculty of Applied Science and Engineering. He was one of the founders of the Canadian Society of Civil Engineers and was long a councillor thereof. He was elected to the presidency in 1909. He was also a member of Institute of Civil Engineers and has served as vice-president of the Canadian Institute of Toronto.

As Dean of the Faculty, Dr. Galbraith devoted himself almost wholly to the upbuilding of the School of Practical Science, steadfastly refusing to undertake any consulting or other work whatever that would in any possible way interfere with its welfare. Being a practical man himself, his policy has been, even against continued opposition, to equip his students with a thoroughly practical education. As a teacher he was strict and even stern in his admintration of discipline and justice, but succeeded in winning the hearts and love of all with his inexhaustible humor and kindness of heart. The esteem and respect in which he was held by the students was best shown at the last annual dinner of the School of Science, when 600 engineers gathered from all over America in honor of the 50th anniversary of his association with the university.

His character was simple and rugged and his personality such that every student was wont to emulate him. To meet him was to feel in him a personal friend, and he never was so busy that he could not give his personal attention and counsel to the youngest student in need of it. The best evidence of his character and work is the high moral and professional standing of the graduates in all parts of the world.

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FREEDOM'S SWORD IS DRAWN.

MOMENTOUS decisions involving practically the whole of Europe in what is likely to be the most bloody war recorded on the pages of history, have been made since our last issue reached subscribers. Our Dominion as a loyal portion of the British Empire is not only a combatant, but, like the other nations implicated, is, as a result, a sufferer in her every sphere of business life and domestic wellbeing. The issue is civilized freedom against barbaric militarism and the desire for a world-wide dictatorship.

As a constituent of the British Empire, and a part of the North American Continent, over all of which the flag of freedom waves, we resent the blasphemous bearing which seeks to corrupt and crush our 20th century civilization. Military domination for the last quarter century has not only sapped the moral stamina of the German people, but has retarded a world-wide advance in science, commerce, the arts and manufactures. This is plainly evident from even a superficial investigation of what the German nation as individuals has accomplished even under the heavy yoke of militarism.

Canada like the Mother Country, is at war, not with the people of Germany, but on their behalf, and we are out to win. While for some the call has come **to be ready**, to the great majority of us, it will be sufficient because of a duty well done, if we are **steady**. Let us keep cool then, whatever the sacrifice required, for only by so doing those at the front on our behalf and their dependants at our side will receive that encouragement and assistance which they must assuredly need.

◆

ADVANTAGES OF SUPERHEATED STEAM.

RECENT achievements with the use of superheated steam have raised it to a place in the list of necessities to economical power development. The benefits to be derived from its employment were known in the time of Watt but, up till comparatively recently it has been little used on account of the lack of materials and workmanship required to withstand its effects. The difficulties have now been so far overcome that a steam plant or even a locomotive not so equipped is like a mechanic without a tool kit.

Recent tests by the Canadian Pacific Railway Co. record savings of over thirty per cent. in coal used. This in some cases has materially shortened the time between certain points by allowing trains to go longer and further without replenishment of water and fuel. We have on record a recent case of a factory engine which taxed the boiler plant to its limit to produce 133 horse power, but which with the addition of a superheater and the same amount of fuel now produces 150 horse power.

There is easily deduceable reasoning to explain all these gains in efficiency. It is well known that the losses due to condensation of steam in pipe lines and engine cylinders runs all the way from 10 to 40 per cent in systems using saturated steam. This can be largely if not entirely saved by superheating. It requires but half the amount of heat to raise the temperature of steam as it does to raise the temperature of an equal quantity of water to a similar extent. Dry steam will not give up its heat as fast as wet steam. A superheat of 100 degrees, that is, the addition of 100 degrees to the temperature of the steam as it comes from the boiler will carry it 1,000 feet in average steam piping arrangements without condensation. The superheating unit need not add materially to the quantity of coal used to produce saturated steam, as the superheater is usually placed in a part of the furnace low in generation efficiency. Its addition may be regarded as extra heating surface, which cannot but improve the performance of the whole plant.

The greatest impediment to the adoption of superheated steam was the difficulty of maintaining pipe joints and fittings and the superheater itself against the ravages of the extra heat. These troubles have practically disappeared with the employment of suitable materials, and by designing the appliance to give only the amount of superheat necessary. The addition of this unit to the plant, unlike many other innovations of modern times, requires few radical changes.

Instruction Course for Power Plant Operators--IV.

By M. L. Smith, B.A.Sc.

Throughout the writer's experience as a teacher, he has been continually confronted with the query: "Can you recommend a text book for power plant employees?" This, on account of specialization of the different branches of the work and the fact that most books published deal with methods of particular localities, is practically impossible. This series of articles is intended to supply the need, to set forth the technical points so that firemen and engineers can understand and apply them, and be thereby assisted in passing the various qualifying examinations.

IT is surprising what a large number of engineers there are in more or less responsible positions who cannot go about making the adjustments in connection with valve setting to get the best results from an engine. The trouble with most men who are uncertain about this part of their work is that they try to remember a rule for the purpose of doing a job which, above all others falling to the lot of the engineer, requires judgment, reasoning and a clear conception of what is being done at each move. An effort has been made in this course to keep as far away from rules as possible and to give in place such simple reasoning as will enable the young engineer to work out each setting for himself.

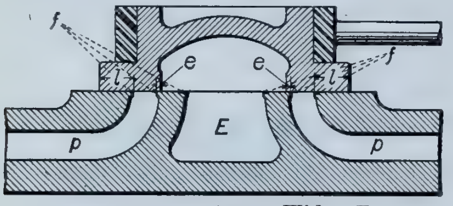


Fig. 26—Effect of Lap to Widen Face of Valve.

The student should familiarize himself with the meaning of every term used. For instance, by **area** is meant the amount of surface, such as square yards of carpet, square feet of wall paper or square inches of piston. It requires two dimensions, length and breadth. The area of a circle 1.128 inches in diameter would be one square inch. By **volume** we mean cubical contents such as gallons of water, cubic feet of gas or cubic yards of concrete. A cylinder ten inches in diameter and twenty-two inches long contains one cubic foot or the same amount as a box one foot square and one foot deep.

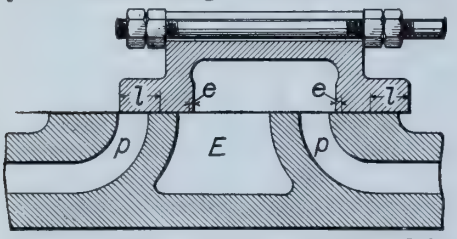


Fig. 27—Position of Valve with Lap Only, with Engine on Dead Center.

Angle of Advance.

In considering the adjustments between eccentric and slide valve, it is necessary to carefully study the relations between the three main parts involved namely, crank, eccentric and valve. The piston is connected with the crank in practically the same way that the valve is linked up with the eccentric and, for this reason, the relation of valve to piston depends upon the relation of eccentric to crank.

It was shown that, if there were no lap on the valve, and consequently no cut-off in the engine stroke, the eccentric crank would be set at right angles or 90 degrees to the main crank. This was done so that the steam port would be about to open when the piston was about to begin its stroke. Now if the valve be made wider by lap on both edges, and overhang the port as shown by (l) Fig. 26, in order that it be about to open the port at the beginning of the stroke, it must be moved farther to the right to the position shown in Fig. 27. This requires that the eccentric be moved just enough ahead of the 90 degree angle to move the valve a distance ahead equal to the lap as shown in Fig. 28. The extra angle is called the **lap angle,** Fig. 28. Thus, for a valve having lap, the eccentric is set 90 degrees plus the lap angle ahead of the crank.

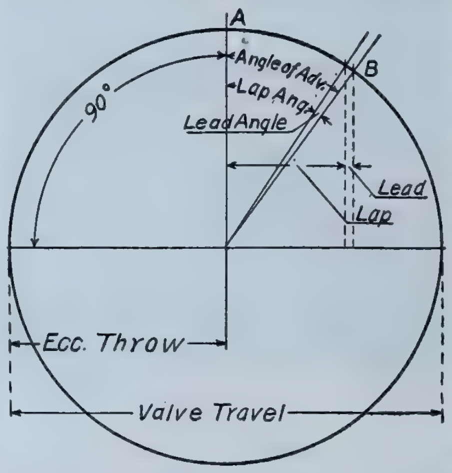


Fig. 28—Determination of Angle of Advance.

One other thing must be taken into account in determining the position of the eccentric. This is **lead.**

Definition:—Lead is the amount measured in parts of an inch that the port is open when the engine is on dead center at beginning of its stroke. The reason for opening the port slightly in advance is that some little time is required to fill the ports with steam at boiler pressure and thus have full power on the piston at the beginning of the stroke when it is most needed.

Exhaust Lap.

The exhaust lap (e) of the valve, Fig. 26, closes the exhaust port E some time before the end of the return stroke of the piston, and thus prevents part of the steam from escaping. This entrapped steam is compressed until its pressure becomes about one-fourth or one-third the boiler pressure, when fresh steam is admitted, and, by the time the piston reverses to go ahead, it is under the full boiler pressure. **Lead** gives to the engine the quality of smartness. That is, there is no waiting or lagging at the beginning of the stroke. Along with the compression comp. it serves to cushion the reciprocating parts, bringing them to a stop and reversed motion without shock. The amount of the lead varies mostly with the speed of the engine and ranges from 1-32 upwards. In vertical engines it is made greater at the bottom than at the top port on account of the weight of the moving parts.

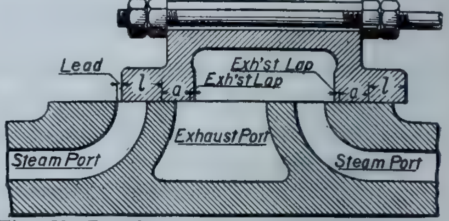


Fig. 29—Position of Valve at Beginning of Stroke, Showing Lead.

In order to give lead to the valve, the eccentric must be set still further ahead of the crank. The small angle required to move the eccentric around the shaft for this purpose is called the **lead angle.** The angle through which the eccentric is thus moved ahead of the quarter position is called the **angle of advance.** If an engine have no lap or lead, there is no angle of advance and, if there be no lead, the angle of advance is equal to the lap angle. If there be both lap and lead, the **angle of advance** is equal to the **lap angle plus the lead angle,** and this is nearly always

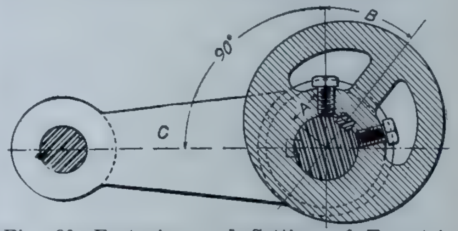


Fig. 30—Fastening and Setting of Eccentric in Relation to Crank.

the case. The eccentric then is usually placed 90 degrees **plus the angle of advance ahead of the crank.** This is shown in Fig. 30.

Setting Of The Slide Valve.

The setting of a slide valve involves two separate operations:—(1) Centralizing the valve travel and (2) adjusting the eccentric. The first operation requires the placing of the engine on the dead center.

To set the engine on dead center:—Procure a scriber, a small center punch and a tram. The latter may be the fancy purchased instrument, but a strong, home-made one is much better for the purpose, as it can be hung up in the engine room and used to set the engine on the dead center whenever it is required to do so without losing time making adjustments. It is simply a piece of round bar steel of suitable length, with the ends nicely pointed and bent over, as shown at T, Fig. 31. First move the fly-wheel until the crank is approximately on the dead center, but a little to one side of it. With the scriber carefully draw a line across the cross head and guide as at d, Fig. 31, and, placing one end of the tram in a center punch mark already made at a convenient point on the frame, scribe a line (a) on the fly-wheel with the other. Now move the engine across the dead point until the scratch on the cross head again comes in line with the one on the guide, and with the one end of the tram in the punch mark on the frame as before, scribe another line (b) on the fly-wheel similar to the first. With a pair of dividers or otherwise, find the middle point (c) between the two lines on the fly-wheel and make a center punch mark at this point. Holding the tram to the punch mark on the frame, carefully turn the engine over until the other end of the tram exactly meets the punch mark in the fly-wheel. The engine is now on one of its dead center points. To locate the other dead point, the same process will have to be repeated with reference to the other end.

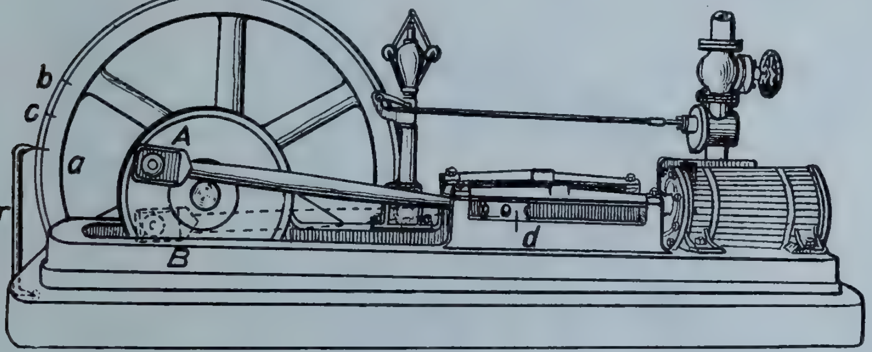


Fig. 31—Placing the Engine on the Dead Center.

The engine construction is often such that it can be placed on the dead center near enough for all practical purposes by means of a level, line, or other direct means, but the method described is applicable in most all cases and is accurate.

Cenralizing The Valve.

In order to have admission, cut, off, etc., occur at the same points in the stroke for both ends of the cylnder, the valve must move centrally about its seat. That is, it must be the same distance to one side of the steam ports when the piston is at the end of its forward stroke as it is to the other side when the piston is at the end of its return stroke. In other words, the steam ports must be in the center of the valve travel. There is always some way provided for adjusting the length of the valve stem or eccentric rod, or both, which may be at the eccentric strap, the slide, or at the valve itself. To determine if the valve is central with the ports, set the engine on one dead point and measure the distance between the edge of the valve and the edge of one steam port. Next set the engine on the other dead point and likewise measure the distance between the other edge of the valve and the similar edge of the other steam port. The valve stem should be lengthened or shortened so as to make these distances the same. In Fig. 32 is shown a properly centralized valve. It is seen that in B the left hand edge of the valve is the same distance from the edge of the steam port as the right hand is in C.

Setting The Eccentric.

The setting of the eccentric determines when the different events of the stroke will occur. Thus, if they come too early the eccentric must be set back, and if too late, it must be set ahead. The valve being centralized, place the engine on dead center and move the eccentric around the shaft ahead of the crank until the lead is exactly the amount desired (Fig. 29) and fasten the eccentric. This setting can be verified by moving the engine to the other dead point and seeing that the lead comes exactly the same at the other edge of the valve.

In cases where the eccentric has slipped and the valve stem adjustments have remained intact, this latter method of setting the eccentric is all that is required. The eccentric is usually keyed and set-screwed solidly to the shaft (Fig. 30), so that this very seldom happens. When the eccentric and valve stem connections become disarranged, they can be simply adjusted until the leads become equal for both ends. This is known as setting the valve for equal leads. In Fig. 30, A = eccentricity and B = angle of advance.

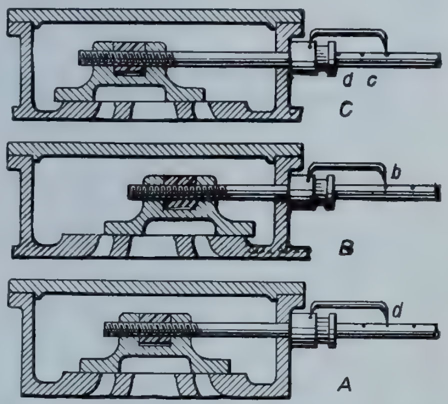


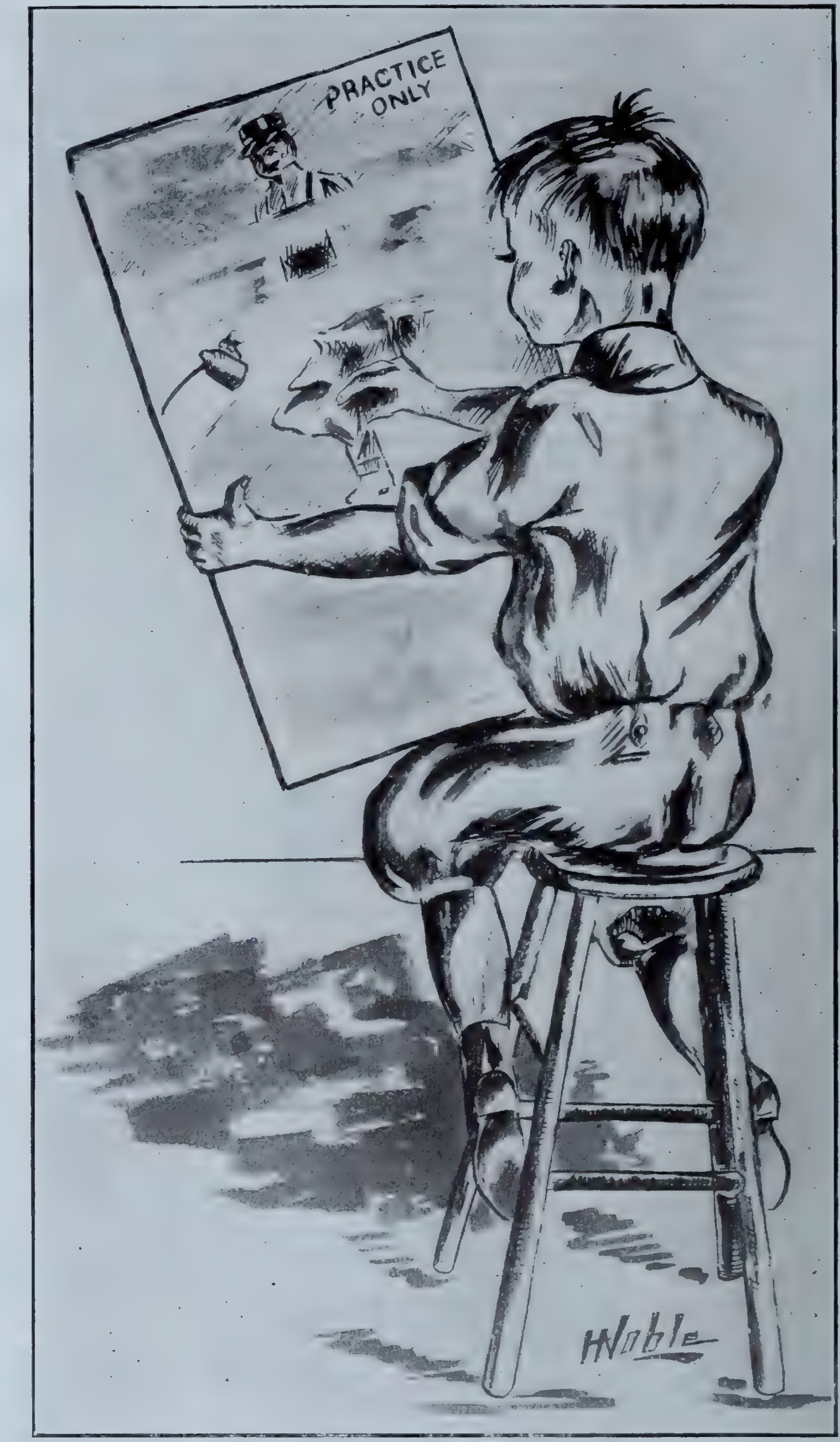
Fig. 32—Valve Stem Arranged to Make Adjustments Without Removing Steam Chest Cover.

This description of valve setting applies to the simple slide or piston valve which is direct connected; that is, there is no reversing rocker arm between the eccentric and the valve. The setting of other kinds of valves will be explained under the heading of **Valve Gears.**

A method of marking the valve stem so that adjustments can be made at any time without removing the steam chest cover is shown in Fig. 32. A center-punch mark is first made on the stuffing box (not gland), and with a solid tram as shown, lines are made on the valve stem when the valve is in the three positions, namely—in mid position, as at (d) in A; for beginning of forward stroke, as at (b) in B, and for beginning of return stroke as at (c) in C. The tram must be carefully kept for this purpose. This method is particularly useful in cases where the valve is attached to the stem by means of a solid yoke or other means that is not liable to become disarranged.

◆

St. John, N.B., No. 22, C.A S.E.—At a recent meeting of this Maritime Province lodge of the Canadian Association of Stationary Engineers, the following officers were elected for the ensuing year: President, John Lobb; vice-president, D. Campbell; financial secretary, Alexander Cruickshanks; recording secretary, E. W. Berry, 519 Main street, St. John, N.B.; treasurer, S. Durham; guards, Watson and Duff; conductor, R. Daley. The secrestary reports the lodge to be in good shape and prospering.



BEING WIPED OFF THE MAP

The fate of the old style engineer who believes in practical experience only and refuses to learn in addition the theory and technique of his calling.

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

CORRECTING DEFECTS IN A SMALL PLANT.

By H. W. Benton.

A FEW years ago the writer took charge of a comparatively small steam power plant, in connection with a wood working establishment, with the sole purpose of building up its much run-down efficiency. The plant consisted of:

One Stirling boiler of 175 horse-power.

One return tubular boiler of 90 horse-power.

One Bates Corliss engine, 16 in. x 42 in., running 86 r.p.m.

One 300-light d.c. dynamo.

One Troy vertical engine, belted to dynamo.

One boiler feed pump, Burnham type.

One boiler feed pump, duplex type.

One 750-gallon underwriter fire pump.

One vacuum pump, Burnham type, on heating system returns, installed during alterations to heating system.

One feed water heater, closed type.

One blast coil heating unit, 7,000 feet of 1-inch pipe.

One blast coil heating unit, 5,000 feet of 1-inch pipe.

11,000 feet of 1-inch pipe for direct radiation (wall coils).

History of Plant.

The manager and owner of the factory asserted that when the plant was new it was but a boy's job to make all the steam required with the Stirling boiler alone, and that frequently there was more refuse from the shop than could be burnt in the boiler-room, so that very little coal was used. For months, however—yes, for almost two years, they had to fire both boilers, and were using a large quantity of coal. The power return was poor, the heating service was described as awful, and altogether the plant was considered very expensive and highly unsatisfactory. He also stated that they were doing more business of late years, and, of course, the plant had more work to do than when new; nevertheless, the cost of power had gone up out of all proportion to the amount of increase of output from the factory, while, as a matter of fact, the cost of power per unit of output from the factory should have gone down. In conclusion, he said that he thought by keeping the plant in operation, and taking advantage of available opportunities such as holidays, shut-downs for inventory, etc., that six months' time would be required to get everything into good operating condition again.

The Factory Product.

This firm bought all their timber in the log; in fact, they bought timber standing in the bush and had their own bush gang to cut the trees down and ship the logs to the factory. The logs were sawn into the required sizes of boards, etc., to suit requirements. The output was a special high grade of furniture, machinery and power being thus required to carry out the whole process from the log to the finished article.

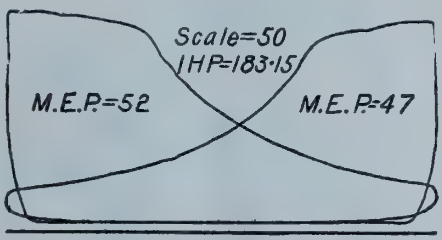


FIG. 1. BATES CORLISS ENGINE DIAGRAM. R. P. M., 86. SAW MILL ON.

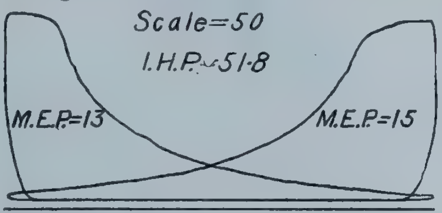


FIG. 2. BATES CORLISS ENGINE DIAGRAM. ENGINE RUNNING LIGHT.

Manufacturing Process.

The saw mill and all machinery was driven by a Bates Corliss engine. The sawmill, on account of running intermittently, about one hour at a time, and from four to six runs per day, was belt driven from the line shaft by a Hill clutch pulley. The power plant had become so run down that it was practically impossible to keep steam for the driving of the complete mill along with the sawmill. The sawyer always gave the fireman 10 to 15 minutes' notice before putting the sawmill on, so that steam pressure could be got up to the point of popping the safety valve—125 lbs. per sq. inch—by the time the sawing began. Frequently the fireman had to ask the sawyer to shut the sawmill off before the skid of logs were sawn up, because he could not hold the pressure up. The heating system also was very poor. It was intended to use the exhaust steam from the Bates Corliss for heating purposes, but this was a failure. The exhaust was wasted to the atmosphere, and live steam direct from the boilers was used at from 60 to 100 lbs. pressure in the heating system mains.

It may be easily imagined that the plant was, when the writer took charge, something like a runaway horse. It had gotten loose and was running wild, and the proposition was to harness these wandering heat units so as to utilize them for the good of the cause.

Did you ever hear the "power house" language? Say, does it not make your ears and eyes sore to walk into a plant and hear and see the different apparatus groaning out loud for someone to take the reins and help them to work together efficiently? Did you ever notice an engine plugging along, loaded to the limit with about 20 or 22 inches of vacuum on the condenser? My, how that same engine would leap for joy and almost run away with that same load if someone would tune up that condenser so as to get a vacuum of from 26 to 27 inches. It is the 5 inches more vacuum that cuts the coal bill.

So it goes on. To the trained person everywhere in a power house, each appliance talks either a contented, efficient message, or a plea to "Please, oh, please," give them a chance.

Method of Procedure.

I will try to explain in detail how the efficiency of the plant in question was tuned up. Examination of the Stirling boiler showed it to be very badly scaled. I was informed that four men had spent two full Sundays with an old turbine cleaner to get the scale out, and that they had only gotten through 16 tubes. This is 80 hours time for 16 tubes, or approximately $100 for labor to clean this one boiler. At this rate, the first tubes cleaned would be dirty again before the boiler could be turbined throughout.

I advised the manager to buy, on thirty days' approval, a different make and type of tube cleaner, and this he did, so that on the following Sunday we had the new outfit to start work with. The new machine was started at 8 a.m., was kept steady at the job all day, and at 11 p.m. every tube in that boiler (132) was thoroughly clean. Two men were on the job from 7 a.m. to 11 p.m., 32 hours time at a cost of $9.60.

It should be clear that the new machine was a good investment, and was accepted and paid for before the thirty days had expired. In this one day's work we removed seven ordinary wheelbarrow loads of scale.

The next move was to examine the Bates engine. Upon this being done the piston was found to be quite loose in the cylinder bore, the snap rings also being loose in the piston. The cylinder was worn out of round, and the valves were so worn that they leaked badly. The manager was advised of the condition, and told that the cylinders would have to be re-bored and fitted with a new piston, and that the valve ports should be bored out and a new set of valves machined and fitted in.

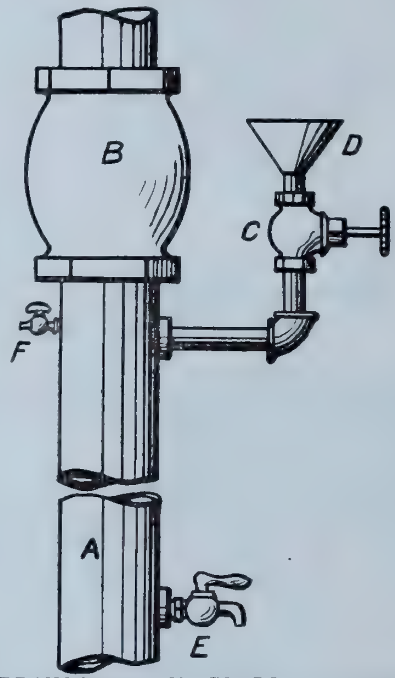
This was a new one on the manager, and, to prove to him the importance of these necessary repairs, I dictated a letter to the builders of the engine, stating size of boilers in service, coal consumption, size of other steam lines taking steam from the boilers, what type and size of machines were using this steam, and an estimate of the total steam consumed, together with a set of indicator diagrams taken from the engine. The letter was closed with the question:—"After a consideration of the conditions as stated herein, would you advise us to have this cylinder re-fitted?" Their answer was very decidedly in the affirmative. Some two days were spent in locating a machine shop qualified to do the work for us. Arrangements were made to shut the plant down on Saturday at noon, and to get the cylinder and parts to the machine shop Saturday night as soon as possible. Castings were received from the builders of the engine from which to machine the new set of valves and new piston and piston rings.

Quick Repair Work.

At 12 noon on a Saturday, as arranged, the throttle was closed, four men were chosen for the job, and at 3 p.m. the engine cylinder was loaded on a truck for its 12 mile journey to the machine shop. This meant three hours' time to strip the cylinder from its base, frame and piping, to move it 80 feet from its foundation to the truck and load it. All work was done by hand, there being no crane or other hoisting device to help make an easy job of it. The team was hooked on to the truck, and at 7.10 p.m. the machine shop crane hooked on to the cylinder and hoisted it into the boring machine.

At 10 p.m. Tuesday night the cylinder was back at the factory, and at 7 a.m. Wednesday morning the engine started off on the job again. During the morning we lost almost a hour, as we had to take out two of the valves and ease them off a little, as they had been fitted a little too tight. There could, however, be no complaint on this score, for the whole job was carried through in splendid time. The cylinder was re-bored, a new piston, pison rod, and new snap rings made and fitted. The valve ports were bored out, and a new set of valves and valve stems machined. The work was completed with but a loss of two days' time at the factory.

There were still two engines to look after. These were the blast coil fan engines and, although not a fancy make of machine and small, were still capable of wasting a lot of fuel. I do not believe I ever saw engines in service in a worse mechanical condition than these. The pistons and rings were awful and the valves, well the whole affair would do better as a screen than an engine cylinder; anything smaller than a marble would go through. These were taken, one at a time, to the shop, bored out, and fitted with new piston rings and rods. The steam chest was also bored out and bushed, piston valve turned up true and the bushing bored out to fit the valve. This made a good job of the fan engines, and, as these units ran twenty-four hours per day, the saving after the overhaul was considerable.



ARRANGEMENT OF COMPOUND FEEDER.

At this stage of the game, we cut out the 90-horse-power return tubular boiler and got along splendidly with the Sterling boiler alone and only once in a while did we have to crowd the latter on account of extra steam required for some jobs in the steaming and bending department.

The defects of the heating plant and their removal will be dealt with in our next issue.

SIMPLE COMPOUND FEEDER.

By J. Ellethorn.

A number of manufacturers are placing on the market various kinds of boiler compounds which require to be fed into the boiler in quantities ranging from half a pint upwards. These doses must be administered every few hours or at stated periods, and must be forced into the boiler, not drop by drop, as is the usual way to feed compound. It has to be given all at once or in the form of a pill. The Johns-Manville Co., of Toronto and the States, might be mentioned as one of these firms. The writer has worked out the following simple arrangement for the purpose of feeding just such mixtures:—

In the accompanying sketch, A is the discharge pipe from the feed pumps to the boiler; B is an upright check valve; C a ⅜ in. globe valve; D a funnel; E a ⅜ in. drip cock, and F an air cock. The operation of the device is as follows:—

Open cocks E, C and F, which will empty the pipe A between the upright check valve B and cock E. Close E and fill the empty pipe with compound by means of the funnel D. Now close C and F, start the pump and the dose will be forced into the boiler.

This is really a fool-proof feeder, is easily made, is not patented, and requires but a few seconds to fill and empty.

* * *

Soot Fall Data. — Careful measurements were made during the past year by means of which it was determined that the soot fall in Pittsburg ranges from 595 to 1,950 tons per square mile per year. London, England, has been considered one of the "gloomiest" cities in the world, yet the soot fall there is only 426 tons per square mile per year.

Superheating and Dissociation—It is stated that, by ordinary methods of superheating, part of the steam is split up into its constituent gases, oxygen and hydrogen, and that it is to these gases, and not to the high temperature, that the destructive effects of superheated steam on oil, packing, and certain metals are due. This dissociation, which takes place at 1,300 degs., approximately, may be avoided by arranging that none of the parts of the superheated become red hot or nearly approaching red heat.

PROPOSED ENGINEERING AUTHORITY

By W. J. Dick.

IN Western Canada there are usually a number of coal seams quite close together, and, should the lower seams be the more desirable with regard to quality and ease of working, there is nothing to prevent the operator from mining them first. In fact, this practice is now being followed in a number of cases in the West. As a result, caving of the measures will render it difficult, and, in many cases, impossible, to recover the coal from the upper seams. Owing to the wide distribution of coal, and the granting of leases to anyone desiring to mine it, the operator who looks to the future and mines the coal in a systematic manner, at an additional cost to himself, has to compete with the operator who takes the easiest available coal. There is, therefore, little encouragement to use other than wasteful methods.

A case came under notice where, owing to a great demand for coal, the directors instructed a mine manager to produce an output greater than the development work justified. The mine manager was forced, against his better judgment, to obtain the coal wherever he could. Some pillars were extracted and others were reduced to such dimensions that they were not able to bear the weight of the superincumbent strata. As a consequence, there was a squeeze, and to-day the mine is badly wrecked and much coal has been lost. In this case, the opinion of an engineering authority would have stood between the mine manager and the directors of the company.

It is suggested that an engineering authority be appointed by the Dominion Government to approve of the methods to be employed at all mines operated under a Dominion Government lease, and that the chief inspector of mines of each province be associated with the engineering authority in so far as matters relating to the operation of mines in that province are concerned. It would also be the duty of such authority to investigate all applications for leasing of coal lands and to determine the conditions under which such leases should be granted.

* * *

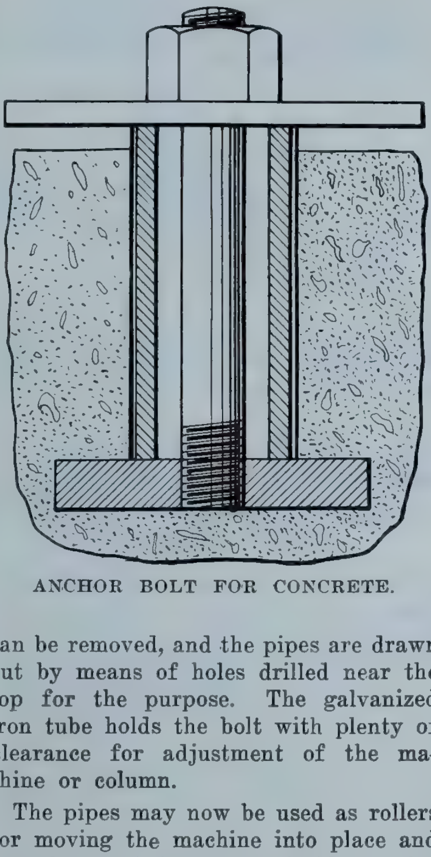
ANCHOR BOLT FOR CONCRETE.

By Alfred McCormack.

WITH the passing of the use of brick, stone and wood for the foundations of buildings and machinery and the substitution of concrete, there arises the necessity of devising new means of placing the holding-down bolts. Many different ways have been tried and adopted. The most natural, probably, is to simply bed the shank of the bolt solidly in the concrete. This has many disadvantages, most of which are known to the man who has to do the setting up of the machinery or superstructure.

The most convenient method which has been met with by the writer throughout a wide experience is shown in the accompanying cut. It consists of a central tie-rod fitted with a standard nut at the top and a special cast iron nut or tapped steel plate for the bottom. A piece of standard W.I. pipe large enough to leave a space as shown around the bolt is next clamped between the two nuts and outside of this again and fitting fairly closely across is a galvanized iron tube.

The bolts are hung in the templet in the usual way at the required elevation, all burrs having been first removed from the ends of the pipe, and the nuts are tightened up. After the concrete has been run in and has set, the templet can be removed, and the pipes are drawn out by means of holes drilled near the top for the purpose. The galvanized iron tube holds the bolt with plenty of clearance for adjustment of the machine or column.



ANCHOR BOLT FOR CONCRETE.

The pipes may now be used as rollers for moving the machine into place and can afterwards be cut to suitable lengths, replaced and used to support the machine in the proper place while the grout is setting.

Some of the advantages of these anchor bolts are, that if the bolt be originally made too short or too long, they can easily be removed and made right without disturbing the machine. The millwright can easily satisfy himself that the bolts are gripping tightly and in the proper places. Then again, there is no danger of injury to the bolts by careless lowering of a heavy column upon them.

INSTRUCTION FOR ENGINEERS.

By James E. Noble.

THE Editorial, Practical Education for Engineers, in the July issue of **The Power House**, contains considerable truth. Any engineer who carefully studies each month's advertisements, sends for makers' circulars and catalogues, and in addition studies their contents will be sure to increase his knowledge of the power plant game. Although I have taken several courses of engineering instruction from correspondence schools and consider I have received value for every dollar they cost me, I consider such a course almost unnecessary now if the engineer is a subscriber to a good journal.

At present there are instruction courses for engineers running in **The Power House** and also in other engineers' journals, which I am sure are equally as good as any sent out by the mail teaching schools, and at a fraction of the cost of the latter. The **Arithmetic Course** being printed in **The Power House** is greatly superior to what I obtained in the mail courses twelve years ago, while the **Practical Questions and Answers** is a line of practical education which no school on earth, resident or correspondent, can hope to touch when the questions come from the men in charge of power plants.

The letters from engineers is another line that has the schools beat to a frazzle, as there is no guesswork or theory in the experiences given.

The machinery and equipment described in the **New Equipment Department** is right up-to-date, and is obtainable only in two ways; from the pages of the journal or from the manufacturer. The journal will give you information on this subject for a few cents a month, being less than the postage alone will cost you if you apply to the makers.

When on the subject of postage I might mention that it is a good idea to enclose a few stamps when sending for catalogues, especially when you do not intend to purchase any of the goods described; also explain to the dealers that you are not in the market at present for any of their goods but wish to investigate their merits. The dealers will appreciate your honesty and will send the catalogues willingly, if their goods are reliable, depending on your good opinion to advance their interests should you get the opportunity. I have done this myself in many cases and no doubt hundreds of other engineers have done likewise, and in the twenty years I have been an engineer I have only been refused catalogues by one firm.

Many text books published are of little use to the engineer whose stock of technical knowledge is small; on the other hand there are a large number of text-books published which will be a paying investment, for any man with ordinary intelligence can understand them, because they are printed in very simple language and no high-brow arithmetic is used. Their principal value lies in the fact that they contain a great quantity of information in a condensed form, carefully indexed, and it is only a matter of seconds to find some forgotten formula.

I fail to see how any engineer can operate continuously without a few good text books at hand for reference in an emergency, for no man, have he ever so good a memory, or be he ever so good an engineer, can remember all that it is necessary to comprehend in the modern plant.

One advantage that the school has over the journal is due to the fact of its cost being high, ranging anywhere from $60 to $175, so that the engineer wishing to get value for his money will necessarily apply himself to mastering the lessons. The journal may contain far more and better lessons, but as it costs him less than two cents per week he does not place the value on it which he does on the school course. He runs through the pages and is satisfied if he sees an item or two which interests him. If he paid a dollar per copy for his journal he would study it more, and it would therefore be cheap to him. I am not referring to **The Power House** only, there being other journals equally as good.

Practical experience is a mighty fine thing to have, but it is absolutely necessary to have considerable technical knowledge, obtainable by study only, to be a real engineer. Toronto has the advantage in this respect over many other Canadian cities as its Technical School gives a course of personal instruction free of charge, further, the lectures given at engineers' organization meetings is both an enjoyable and profitable way of increasing a man's knowledge.

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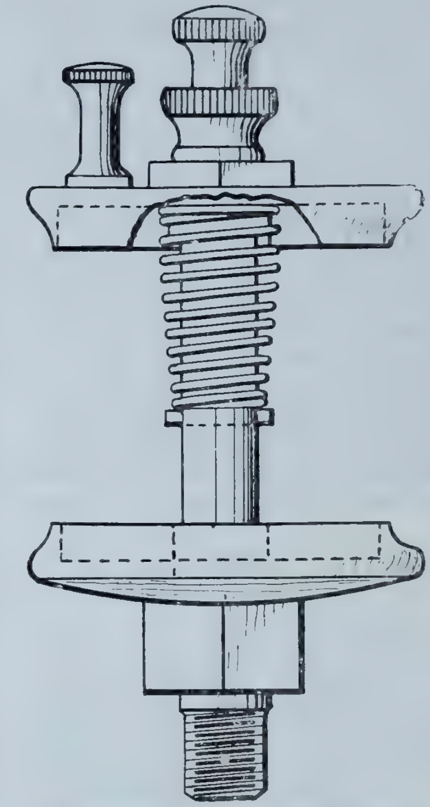
AN IMPROVED OIL CUP.

By F. A. Wright.

THE oil cup herewith illustrated is a standard patented article for oiling engine crank pins. It is arranged to supply the proper amount of oil to the bearing while the engine is running, and to shut off the supply when it is stopped. The one fault with the apparatus was forcibly brought to the attention of the writer upon several occasions.

When the glass was accidentally broken, the heavy brass cover became loose and unmanageable, and it was but a short time before the complete apparatus became a wreck and had to be replaced. By drilling a small hole in the shank and placing the stop pin and spring, as shown, the repairs necessary were minimized. The spring furnished a strong and elastic support for the cover upon the glass being disabled, so that in case of breakage further damage was prevented and the renewal of the glass alone was required.



AUTOMATIC CRANK PIN OILER.

◆

DOES THE STATIONARY ENGINEERING PROFESSION PAY?

By J. W. Armour.

I AM a new subscriber to **The Power House**, and would like to add more to the interesting letters I see there by your practical readers. Some time ago in another journal the question was asked: "Does the Stationary Engineering Profession Pay?" There is so much embodied in the question that it can only be answered in full by using up several pages of your paper; however, I will endeavor to give a part answer.

To the men mechanically inclined and not afraid of work and dirt, a great deal of pleasure will be found in meeting, solving and overcoming the problems encountered in most steam plants. Therefore, it will pay this man to be an engineer, even if his salary be small. To the man who dislikes his work and only does what he is compelled to do, letting everything get dirty and out of order, which it is not absolutely necessary to attend to, the engineering game is a failure. If the question is to be answered from a money standpoint of view only, there is more to be said. There is no doubt that a great many stationary engineers receive very small pay. It is a fact that they receive less compensation in proportion to the danger and responsibility they assume than any other class of workmen, but this is not so in all cases. Big plants are being built right along now, and the man who will study and work until he feels confident he can fill a better position will stand a chance of getting a position at his chosen work that will pay him in money. Still, I am sorry I can only say it is a chance game even if he make himself competent or as nearly so as a man of ordinary intelligence can be expected to do. He is not in any sense sure of landing a position that will pay him an honest return for the knowledge and work he is ready and willing to give in return.

Why is this so? One reason is this. Here in Ontario a man has to pass the same examination for taking charge of a little 4 by 6 affair in a steam laundry as the man who has the responsibility and the charge of a 1,000-horse-power plant. Surely the better man has no advantage here, so far as the license goes. It is a fact that many employers overlook the fact that it is necessary for their own financial benefit that a capable man should be in charge of their power plant, where thousands of dollars can be saved or sent up the chimney, and in other ways squandered. Happily, this kind of employer is becoming fewer all the time, and his class will soon become extinct. Let it be soon.

The engineer's prime requisite is a knowledge and familiarity with the operation and principles of modern power plant apparatus. This knowledge, etc., is being brought to him at regular intervals by such papers as **The Power House.** These contain the very latest information on stationary engineering practice by the most eminent practitioners, and although text-books are good, much that is old and out of date will be found in many of them, and should be carefully weeded out when studying them.

The regular visitor and instructor in the shape of a journal contains the very latest and best, but it is of no use to the engineer who just looks at the illustration and neglects to study the text. To get back to tin tacks, the engineer must work and study, be faithful to his employer, be able and willing to make all ordinary repairs, and study his daily problems.

How can stationary engineering be made to pay? If each operator follows this advice he will solve it in his own case, for he will stand the best chance of securing a better paying position than he now holds.

Arithmetic for the Machinist and Operative-Engineer

By J. H. Rodgers

With the further development of this course in arithmetic, it will be found by those who have followed the introductory lessons and profited by them that the various practical applications resulting from the succeeding lessons will be easily observed and their time and labor-saving features so appreciated as to be adopted at every available opportunity.

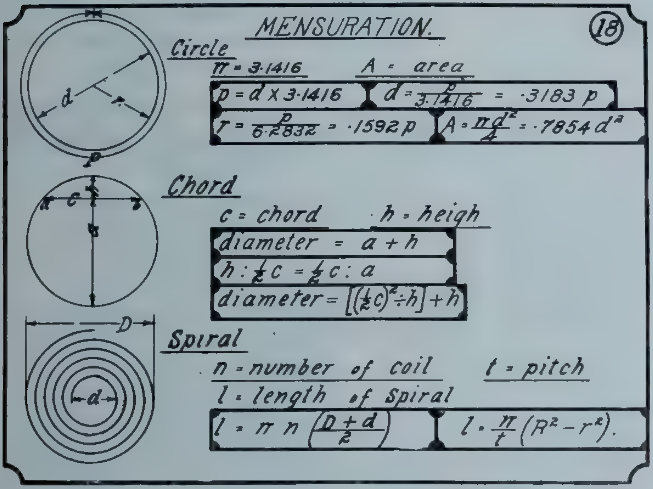
MENSURATION.

MENSURATION is that branch of geometry which treats of the measurements of lines, surfaces and solids.

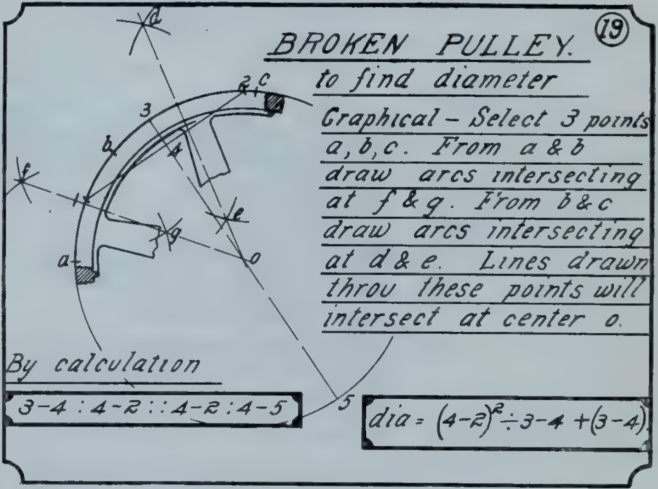
The area of a surface is the number of unit squares it contains, usually expressed in square inches, square feet or square yards.

The expression sq. inches, should not be confused with the expression inches square; for instance, while an inch square would represent one sq. inch, the expression—3 inches square means a square figure that measures 3 inches on a side, and would represent $3\times3=9$ square inches.

The area of any triangle equals one-half the base multiplied by the height.



ARITHMETIC CHART 18.


BROKEN PULLEY.
19
to find diameter
Graphical – Select 3 points a, b, c. From a & b draw arcs intersecting at f & g. From b & c draw arcs intersecting at d & e. Lines drawn throu these points will intersect at center o.
By calculation
3-4 : 4-2 : : 4-2 : 4-5
dia = (4-2)² ÷ 3-4 + (3-4)
a
b
c
d
e
f
g
o
1
2
3
4
5

ARITHMETIC CHART 19.

The area of any irregular figure bounded by straight lines can be found by dividing the figure into triangles and finding the area of each separate triangle; the sum of all the triangles equals the area of the figure.

To find the circumference or diameter of a circle.

Circumference equals the diameter multiplied by 3.416, and diameter equals the circumference divided by 3.1416, or by the formula (Chart 18:

$$p = d \times 3.1416 \text{ or } d = \frac{P}{3.1416} = .3183p.$$

The area of a circle equals the square of the diameter multiplied by .7854 or by formula

$$A = \frac{Nd^2}{4} = .7854d^2$$

Example:—A certain belt has a speed of 1,250 ft. per minute, what is the diameter of the driving pulley if the speed of the driving shaft is 160 revolutions per minute?

The circumference of the pulley will be the surface speed in inches, divided by the speed of the shaft, or

$$\frac{1250\times12}{160} = \frac{375}{4} = 93.75 \text{ inches, then}$$

$$\text{diameter} = \frac{93.75}{3.1416} = 29.8 \text{ ins., or a}$$

30-in. pulley.

Example:—If the mean effective pressure in an engine cylinder be 65 lbs. per sq. in., and the diameter of the piston is 16 ins., what is the total force acting on the piston?

The total pressure will be the pressure per sq. in. multiplied by the area of the piston, or $65 \times .7854\ d^2 = 65\times.7854\times16\times16 = 13{,}069$ lbs., or 6½ tons.

To find the diameter of a circle when the length of a chord and the height of the segment are known. (See Chart 18.)

The height is to half the chord as half the chord is to the diameter minus the height. $h : .5c = .5c : a$ or diameter $= [(.5c)^2 \div h] + h$.

Example:—To find the diameter of a broken flywheel. (See Chart 19.)

This may be obtained either graphically or by calculation. Select three points (a) (b) (c) upon the rim of the broken section; then with radius greater than half the distance a.b.) describe arcs intersecting at (f) and (g). Similarly from (b) and (c) describe arcs intersecting at (d) and (e). The production of these bisecting lines will intersect in the centre (o).

By calculation: If in the broken section (Chart 19), the length of the chord (1—2) equals 18 inches, and the height (3—4) equals 1.125 inches, what is the diameter of the flywheel?

By formula:—
diameter $= [(4\text{-}2)^2 \div (3\text{-}4)] + (3\text{-}4)$ or $(9^2 \div 1.125) + 1.125 = 73.125$ inches.

To find the length of a spiral.

Multiply one-half the sum of the large and small diameters by 3.1416 times the number of coil.

Example:—Large diameter of a roll of belting measures 15 inches, the inner diameter 3 inches, and the number of coils equals 24; what is the approximate length?

$$\text{By formula: } t = -w\,n \left\{\frac{D+d}{2}\right\} =$$

$$3.1416 \times 24 \left\{\frac{15+3}{2}\right\} = 678.61 \text{ in. or}$$

56 feet 6 inches.

Mensuration of Solids.

In the foregoing lesson, mensuration or measurement of lines and surfaces is explained, and examples of its practical application given relative to familiar shop equipment. The measurement of solids is discussed in the present instance, well known accessories to mechanical engineering products being again the examples of its application.

A solid, or body, has three dimensions;

length, breadth and thickness, and the entire surface of a solid is the area of the whole outside of the body, including the ends. The volume of a solid is the number of unit volumes it contains, as cubic inches, cubic feet, etc.

A prism is a solid whose ends are equal polygons, and parallel to each other and whose sides are parallelograms.

A cylinder is a round body of uniform diameter, with circles for its ends.

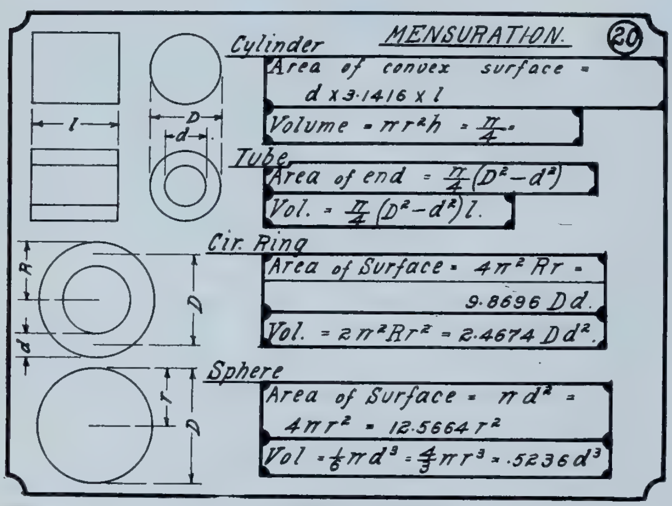
The convex surface of a right prism or cylinder is the perimeter multiplied by the height or altitude. The volume of a right prism or cylinder equals the area of the base multiplied by the height. (See Chart 20.)

A cone is a solid whose base is a circle and whose convex surface tapers uniformly to a point called the vertex. The convex area of a right pyramid or cone equals the perimeter of the base multiplied by one-half the slant height. The volume of a right pyramid or cone equals the area of the base multiplied by one-third the altitude.

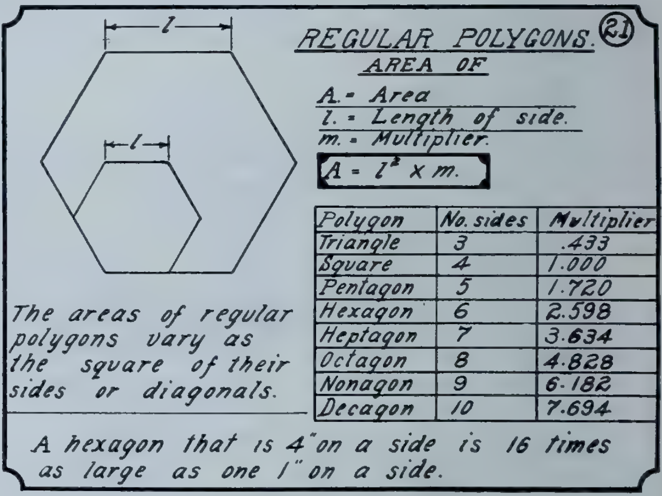
If a pyramid or cone be cut by a plane parallel to the base, the lower portion is called the frustrum of a pyramid or cone. The volume of a frustrum of a pyramid is found by multiplying the sum of the areas of the upper base, the lower base, and the square root of the product of the areas of the two bases, by one-third the altitude, or by formula:

$\text{vol.} = 1/3\ h\ (A + a + \sqrt{A \times a}),$

in which h = altitude, A = area of upper base, and a = area of lower base.


MENSURATION.
⑳
Cylinder
Area of convex surface = d x 3·1416 x l
Volume = πr²h = π/4.
Tube
Area of end = π/4(D² − d²)
Vol. = π/4(D² − d²)l.
Cir. Ring
Area of Surface = 4π² Rr = 9·8696 Dd.
Vol. = 2π²Rr² = 2·4674 Dd².
Sphere
Area of Surface = πd² = 4πr² = 12·5664 r²
Vol = 1/6πd³ = 4/3πr³ = ·5236 d³
l
D
d
R
d
D
r
D

ARITHMETIC CHART 20.


REGULAR POLYGONS.
㉑
AREA OF
A. = Area
l. = Length of side.
m. = Multiplier.
A = l² x m.
l
l
The areas of regular polygons vary as the square of their sides or diagonals.
A hexagon that is 4" on a side is 16 times as large as one 1" on a side.

Polygon	No. sides	Multiplier
Triangle	3	.433
Square	4	1.000
Pentagon	5	1.720
Hexagon	6	2.598
Heptagon	7	3.634
Octagon	8	4.828
Nonagon	9	6.182
Decagon	10	7.694

ARITHMETIC CHART 21.

Example:—What is the capacity of a tub, 14 inches high, 28 inches dimeter at the top and 20 inches diameter at bottom? Assume 7.477 gallons to the cubic foot.

By formula:

$\text{vol.} = 1/3\ h\ (A + a + \sqrt{A \times a}),$

Capacity in gallons:

$$7.477 \times \frac{1/3\ h\ (A + a + \sqrt{A \times a})}{1728}$$

$$= 7.477 \times \frac{1}{3} \times \frac{14}{1} \times \frac{1369.81}{1728}$$

= 27.665 gallons.

A sphere or ball is a solid bounded by a uniform curved surface, every point of which is equally distant from the centre. The area of the surface of a sphere equals the square of the diameter multiplied by 3.1416. The volume of a sphere squals the cube of the diameter multiplied by .5236 (see Chart 20).

Example:—Required the diameter of a cast iron ball to weight 12 lbs. Assume the weight of cast iron to be .26 lbs. per cubic inch.

The volume of the ball will be its weight divided by the weight of one cubic inch, or $12 \div .26 = 46.15$ cu. in.

Then by formula (chart 20) volume,

$$= .5236\ d^3 \text{ or } d = \text{cu. rt. of } \frac{46.15}{.5236}$$

= cu. rt. of 88.14 = 4.45 inches.

To find the area of a disk or washer, multiply the difference between the squares of the two diameters by .7854, or by formula (Chart 20):

$$\frac{3.1416}{4}\ (D^2 - d^2) = .7854\ \ (D^2 - d^2)$$

The volume of a hollow tube equals the area of the end multiplied by the length. Example:—What is the weight of a 9-foot length of hollow tubing, with an external diameter of 6 inches, and an internal diameter of 3.5 inches?

Assume the weight of the steel to be .282 lbs. per cu. inch.

By formula (Chart 20),

$$\text{Vol.} = \frac{3.1416}{4}\ (D^2 - d^2)\ L$$

$= .7854\ \ (6^2 - 3.5^2)\ 9 \times 12$

$6^2 - 3.5^2 = 36 - 12.25 = 23.75$

Then weight of shaft:

$= .282 \times .785. \times 23.75 \times 9 \times 12 = 568$ lbs.

To find the area of regular polygons. Square the length of one edge, and multiply by the constant or multiplier found in (Chart 21) using the formula,

$A = L^2 \times m.$

Example:—What is the weight of a 12-ft. bar of hexagon steel whose edge measures 2 in.? Assume the weight of a cu. in. to be .288 lbs.

By formula, $A = l^2 \times m$,
Volume = A×length of bar in inches.
Weight = .288 × volume =
$= .288 \times 2^2 \times 2.598 \times 12 \times 12 = 431$ lbs.

Knowing that the area of regular polygons vary as the square of their sides or diagonals, what would be the weight of a 12-ft. hexagon bar of similar steel whose edge measures 1¼ inches?

Let X = required weight;
$X : 431 = 1.25^2 : 2^2$, or
then

$$X = \frac{431 \times 1.25^2}{2^2} = \frac{431 \times 1.25 \times 1.25}{2 \times 2}$$

= 168 lbs.

Centrifugal Pump Data.—When centrifugal pumps are operated on sandy pulp, the usual result is the cutting out of the impeller shafts at the point where the packing bears upon them. One of the most popular methods of reducing this wear and, in fact, about the only one which has so far proved effective, is to feed water or solution constantly into the gland, thus washing back the sand into the pump. At the plant of the Deloro Mining and Reduction Company, at Deloro, Ont., this procedure is impossible, as the extra liquid added would soon run the tank over. The difficulty is surmounted by using a spiral metallic packing in the gland and feeding hard grease into it by constant pressure. The feeding arrangement is so adjusted that the pressure is just sufficient to keep any solids from entering the gland. Centrifugal pumps so equipped use one shaft for about nine months, whereas before this idea was conceived they would cut out in a few days.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent, practical questions, and give same direct reliable answers. Catch questions will be avoided. Arithmetic, consisting of simple addition, subtraction, multiplication and division of decimals, will be found a most useful companion study, and should not be overlooked.

PROBLEMS IN HYDROSTATICS.

HYDROSTATICS deals with the equilibrium of liquids or with liquids "at rest," whether under pressure or not.

A cubic foot of water weighs 62.35, or approximately 62½ pounds. The weight of a cubic inch is .036 pound. As water is very nearly incompressible, it is particularly useful for transmitting great pressures.

If a body is submerged in water, it is pressed upwards with a pressure equal to the weight of water it displaces, and it is subjected to a pressure equal to the weight of the water above it.

If a liquid be subjected to pressure, that pressure is transmitted equally in every direction except in cases where the weight of the liquid naturally adds itself to the downward pressure.

• • •

Question.—A cylindrical tank, 20 ft. high, is filled with water. What would be the downward pressure on the bottom and the lateral pressure at a point three feet from the bottom in pounds per sq. in.?

Answer.—The pressure on the bottom would be equal to the weight of a column of water one inch square and 20 ft. high, which is

$$20 \times 12 \times .036 = 8.64 \text{ pds. sq. in.}$$

The lateral pressure three feet from the bottom would be

$$(20-3) \times 12 \times .036 = 17 \times 12 \times .036 = 7.344 \text{ pounds.}$$

• • •

Question.—What would have to be the pressure upon the piston rod of a 6-inch pump in order to lift water 300 ft.?

Answer.—The 6-inch piston would have to support a column of water 300 ft. high, and, therefore, would be subject to a pressure of

$$300 \times 12 \times .036 = 129.6 \text{ lbs. sq. in.}$$

Area of piston = 28.2274 sq. in.

Total load on piston and rod would be

$$28.274 \times 129.6 = 3704.3 \text{ pounds.}$$

• • •

Question.—The pressure in a water pipe before the water is turned on is 30 lb. per sq. in. Neglecting friction and other losses, how high should the water go if shot vertically upwards from a nozzle?

Answer. — Theoretically, the water should spout to the same height as would be required to produce the above as a hydrostatic pressure. .036 lb. is produced by 1 inch of water. 30 lb. would be produced by

$$\frac{30}{.036} \text{ in. or } \frac{30}{.036} \times \frac{1}{12} = 69.44 \text{ feet.}$$

which is the height to which the water would rise if no losses were incurred.

• • •

Question.—A hydraulic jack has a pump piston ⅜ in. in diameter and a ram 2 in. in diameter. It is operated by a lever 22 in. long, pivoted at the end, and with the plunger attached 2 in. from the same end. With 50-lb. pressure on the end of the lever, how much could be lifted by the jack?

Answer.—The power arm of the lever is 22 inches and the work arm is 2 in. With a pressure of 50 lb. on the power arm the pressure on the small piston would be

$$\frac{50 \times 22}{2} = 550 \text{ lb.}$$

The area of power piston = area of ⅜-in. circle = .1104 sp. in.

Area of load piston = area of 2-in. circle = 3.1416 sq. in.

550 lb. operating on every .1104 sq. in. of the 3.1416 sq. in. would give a lifting power of

$$\frac{3.1416}{.1104} \times 550 = 15651.1 \text{ pounds, or}$$

about 7.8 tons.

• • •

Question.—James Watt fed his boilers by raising the water tank high enough to cause the water to flow into the boiler by gravity. If the steam pressure were 60-lb. per sq. in., how high would he place his tank above the boiler?

Answer.—The height of water necessary to overcome 60-lb. boiler pressure would be

$$\frac{60}{.036} \times \frac{1}{12} = 138.8 \text{ feet.}$$

• • •

Question.—If the atmospheric pressure be taken as 14.7 lb. per sq. in., how-high would a theoretically prefect pump lift water?

Answer.—The water could be lifted high enough to balance its pressure against that of the atmosphere or

$$\text{height} = \frac{14.7}{.036} \times \frac{1}{12} = 34.207 \text{ feet.}$$

• • •

Question. — The side of a cast iron water tank is fastened at top and bottom. The tank is 8 by 12 by 9 feet high. When the tank is full what would be the strain (a) on top fastenings (b) on bottom bolts?

Answer. — Formula, $P = \frac{1}{2} w h^2 \times$ length, or total pressure against one side $= \frac{1}{2} \times 62.34 \times 9 \times 9 \times 12 = 30{,}297.24$ lbs. It can be proved that this pressure may be considered to act at a point one-third of the distance from the bottom. Force acting against the bottom fastenings or tending to push bottom edge out would be

$$\frac{2}{3} \times 30297.24 = 20198.16 \text{ lb.}$$

or 10.099 tons nearly...............(b)

The force tending to strain bolts at the top is

$$\frac{30297.24}{3} = 10099.08 \text{ lbs.}$$

or 5.049.54 tons nearly ....(a)

◆

RELATIVE TO FALLING BODIES.

PRINCIPLES.—All bodies fall equally fast. That is, a piece of paper and a stone, if dropped into well at the same instant, would reach the bottom at the same time, but for the resistance of the air which has a greater effect upon the lighter bodies. In the following problems the effect of air resistance is not considered.

A falling body accelerates uniformly or, in other words, it gains exactly the same amount of speed for each second during its fall. This increase in speed is known as the force of gravity or (g) and varies slightly at different points on the earth between the equator and the poles. Its value for our latitude is 32.16. It is easily seen that, if a falling body gain this amount in speed each second, its speed at the end of two seconds will be 64.32; at the end of three seconds, 32.16×3=96.48 feet per sec. and so on. From this we get the formula

$$v = gt \quad (1)$$

where v=velocity in ft. per sec.

t=the time in seconds during which the body falls.

g=the force of gravity=32.16.

• • •

Question.—What would be the velocity ottained by a brick after falling during 7 seconds?

Answer. — $v = gt$ or $v = 32.16 \times 7 = 225.12$ ft. per sec.

• • •

Question.—From what height must a stone be dropped in order to strike the ground with a speed of a mile a minute?

Answer.—A mile =5280 ft., and a mile in 1 minute

$$=\frac{5280}{60}=88 \text{ ft. per sec.}$$

For determining the distance in problems of falling bodies we use the formula,

$$h=\frac{v_2}{2g}\text{—(2).}$$

The height from which a body must fall to attain a given velocity equals the square of the given velocity divided by 2×32.16.

In the above formula,

v=velocity in ft. per sec.

h=height in feet.

g=force of gravity=32.16.

Supplying values,

$$h=\frac{88\times88}{32.16\times2}=120.39 \text{ feet.}$$

* * *

Question.—Considering that Niagara Falls is 160 feet high, at what speed does the water strike the bottom?

Answer.—Changing the above formula to suit this case we have

$h=\frac{v^2}{2g}$ that is $v^2=h\times2g$ or $v=\sqrt{2gh}$, applying this to the problem

$v=\sqrt{2\times32.16\times160}=104.4$ ft. per sec.

* * *

Question.—A man in a balloon drops a sand bag from a height of 5,200 ft. How long would it take to reach the earth?

Answer.—Where time is involved we use the formula $h=\frac{1}{2}gt^2$—(3). Changing this to find t we get

$t=\sqrt{\frac{2h}{g}}$ where t is the time in seconds

or $t=\sqrt{\frac{2\times5200}{32.16}}=\sqrt{323.38}=17.98$ seconds.

* * *

Question.—A gun in the crows nest of a battleship, 90 feet above the water, discharges a shell in a horizontal direction, with a muzzle velociety of 144,000 feet per minute. What will be its range?

Answer. — The motion given to the projectile by the powder does not affect the force of gravity and it will strike the water in the same time as if it were dropped. This time would be, according to formula,

$$t=\sqrt{\frac{2h}{g}} \text{ or } t=\sqrt{\frac{2\times90}{32.16}}=\sqrt{5.5970}$$

=2.37 seconds.

In 1 min. the shell goes 144,000 feet horizontally. In 1 sec., it travels $\frac{144000}{60}$ and in 2.37 secs, $\frac{144000}{60}\times2.37=$ 5688 feet or a little more than a mile.

Question.—A ten-foot fly wheel bursts at 1,000 r.p.m. (1) How high will a piece of the rim go which happened to fly straight upwards? (2) At what velocity will it go through the roof 60 ft. above?

Answer. — (1) The initial velocity would be

$$\frac{10\times3.1416\times1000}{60}=523.6 \text{ ft. per sec.}$$

The height to which a body will go is the same as that from which it would have to be dropped in order to acquire the same velocity. Therefore,

$$h=\frac{v^2}{2g} \text{ or } h=\frac{523.6\times523.6}{2\times32.16}=4262.3 \text{ ft.}$$

Answer.—(2) This velocity would be the same as if it were dropped from a height 60 ft. less than this or 4262.3—60=4202.3 ft., using formula

$v=\sqrt{2gh}$ or $v=\sqrt{2\times32.16\times4202.3}$

$=519.89$ ft. per sec.

* * *

Question.—If a 12 -inch emery wheel should burst while making 2820 r.p.m., what would be the greatest horizontal distance that one of the pieces could go?

Answer.—The greatest possible range would be attained by a piece flying off at an angle of 45 degs. with the horizontal. Its initial velocity in this direction would be

$$\frac{2820\times3.1416}{60}=147.655 \text{ ft. per sec.}$$

Its horizontal and vertical initial velocities would be represented by the sides of a right angle triangle, whose hypotenuse is at an angle of 45 degs. In which case, both sides would be the same.

The horizontal initial velocity would be the cosine of 45 degs. × 147.655 or .70711 × 147.655 = 104.404 ft. per sec. The vertical initial velocity would be 147.655 multiplied by the sine of 45 deg., which is, for this angle, of course, the same thing.

The time during which a body is rising is the same as would take it to gain this same velocity in falling from rest and the total time of flight would be twice this as it also has to come down. The formula for this would be

$v=gt$ arranged to find (t) or $t=\frac{v}{g}$

or $t=\frac{104.404}{32.16}\times2=6.49$ seconds.

Its horizontal speed is uniform and is 104.404 ft. per sec. Therefore, the distance it travels is 104.404.49=677.582 ft.

* * *

Question.—In the above problem, how high would the piece go?

Answer.—From the former solution we find that its initial velocity in a vertical direction is 104.404 ft. per sec. Using formula $m=\frac{v^2}{2g}$ we have height

$$=h=\frac{104.404\times104.404}{2\times32.16}=169.47 \text{ feet.}$$

* * *

PROBLEMS IN CENTRIFUGAL FORCE

Question.—A cast iron pulley has a rim 12 in. wide and 1 in. thick. Its outside diameter is 12 ft. 1 in. Neglecting the effect of the arms, at what speed would it be likely to burst?

Answer.—Formula, $F=.00034\,WRN^2$,

$$\text{or } N=\sqrt{\frac{.00034\times W\times R}{F}}$$

The force necessary to separate the wheel in halves would be the force necessary to break the rim in two places. This would be twice the sectional area multiplied by the tensile strength of cast iron, and is, therefore,

$2\times12\times1\times15000=360{,}000$ pounds,

which must be that part of the centrifugal force which acts at right angles to any diameter.

The centrifugal force necessary would be $360{,}000\times2\times\frac{3.1416}{2}=360{,}000\times2\times1.5708$

$F=1{,}130{,}976$ pounds.

1.5708 = relation of diameter to ½ circumference.

Volume $=12\times1\times3.1416\times12\times12=$ 5428.5 cub in.

Cast iron weighs .26 pound per cub. in., therefore weight $=5428.5\times.26=$ 1411.5 pounds.

$$\text{Now } N^2=\frac{1130976}{.00034\times1411.5\times6}=392700.$$

or

$N=\sqrt{392700}=626.6$ r.p.m.

* * *

Question.—In the previous question, if a piece weighing 200 lb. flew off, what would be its kinetic energy?

Answer.—Speed in feet per minute = circumference multiplied by r.p.m.=

$12\times3.1416\times626.6=23{,}617.8$ ft. per min. $=\frac{23{,}617.8}{60}=393.63$ ft. per sec.

Formula for kinetic energy is,

energy $=\frac{1}{2}mv^2$, or in other words,

energy $=\frac{Wv^2}{2g}$, where

W = weight in pounds = 200.

v = velocity in ft. per sec.=393.63

g = force of gravity = 32.16, or

$$\frac{200\times393.63\times393.63}{32.16\times2}=481{,}803 \text{ pounds,}$$

which is the kinetic energy.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

SQUARE END PIPE CUTTER.

IN placing this new 2½ in. to 4 in. pipe cutter on the market the Borden Canadian Co. of Toronto have made a radical departure from the standard design of pipe cutting tools.

The tool consists of two sections, the gripping part, which when in operation has no motion relative to the pipe, and the cutting part, which revolves about the latter. Figs. 1 and 3 show these two sections respectively. To cut off a piece from a pipe, the first operation is to clamp the tool to the pipe. In Fig. 1 the gripping jaws seen are closed by a right and left hand grip screw which is operated by a wrench fitting over its square end. In Fig. 2, showing the cutting section, a similar right and left hand screw sets the knives up against the pipe under tension. The cutting section has a ratchet fitted to it, and by means of a handle fitted into a link on the gripping section, the cutting part is thus made to revolve about the pipe, being actuated through the lever and the ratchet. The knives are fitted with little blocks, and when placed up against the pipe under tension, coil springs behind these blocks are compressed and keep the knives uniformly against the pipe as the cut proceeds. The knives are so shaped that part of the cutter forms a guide which allows the feed never to exceed that for which the cutter was designed. The springs pressing against the little blocks keep the tool always cutting; thus when once set against the pipe the feed is automatic and constant. The tool is a complete unit of cast steel, and a bronze bushing is provided for a bearing surface upon which the cutting section revolves.

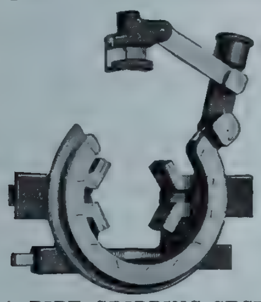


FIG. 1. PIPE GRIPPING SECTION A.

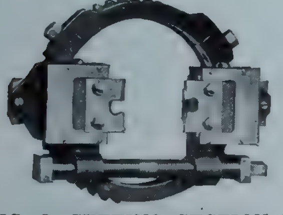


FIG. 2. CUTTING SECTION B.

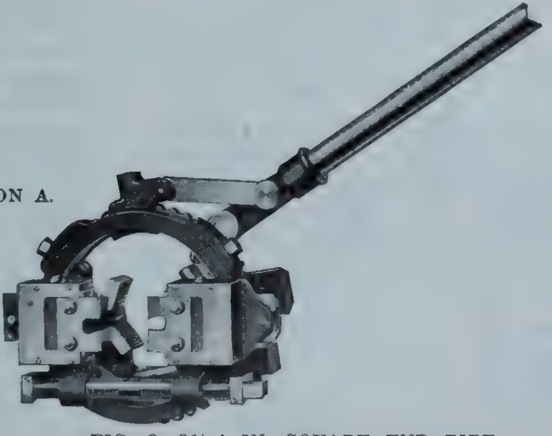


FIG. 3. 2½-4 IN. SQUARE END PIPE CUTTER.

Fig. 3 shows the assembled tool. When the jaws are clamped to a pipe they automatically center the cutting knives so that the pipe is cut off square. As the cutting is done by means of a ratchet, pipes may be cut off in cramped places which would otherwise prohibit the use of an ordinary tool. One man can work the pipe cutter to advantage. In fact, the tool, we understand, is capable of cutting off a 4-in. pipe in four minutes by a man using one hand only. The cut is particularly clean, there being a conspicuous absence of burrs inside and outside. There is, further, little tendency to strain, distort or split the pipe, while the cutter can be quickly adjusted to fit any size from 2½ in. to 4 in. The tool will also cut through a thread as quickly and squarely as a piece of straight pipe.

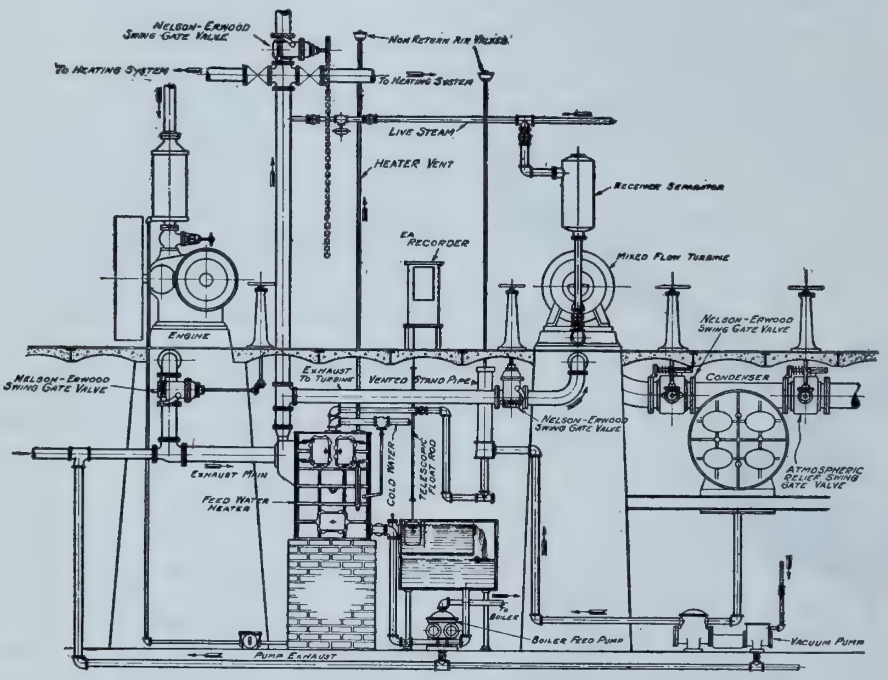
Two extra sets of cutters are supplied with each tool and also a template for grinding. The knives are easily and quickly removed by simply taking out two cap screws. There are practically no parts to get out of adjustment.

SWING GATE AND CHECK VALVE APPLICATIONS.

AN increasing and promising use for the steam turbine is its application as a secondary or low pressure unit in connection with non-condensing or condensing engines, or, combining with a regenerator, in connection with engines using steam intermittently. At first, the most promising application of the low pressure turbine was to use steam from inefficient non-condensing engines which were found in steel mills and mine-hoists, but its field of employment is now extended to efficient power engines in railway and lighting plants as it has been thoroughly established that the most efficient steam plant to-day consists of a compound unit consisting of a reciprocating engine, acting between boiler pressure and approximately atmospheric pressure, and a low pressure turbine which discharges into a condenser.

It was not until the low pressure turbine had been commercially developed that engineers fully realized the significance of the fact that the available energy per pound of steam, between 150 pounds boiler pressure and 28 inches vacuum was cut practically in halves by the line of atmospheric pressure. Reciprocating engines are incapable of utilizing efficiently the energy below the atmospheric line, because to attain the proper degree of expansion requires an enormous cylinder, the friction within which would consume a large portion of the available energy. The turbine, however, can utilize the energy between 26 and 28 inches of vacuum as effectively as it can utilize the energy between atmospheric pressure and five pounds below. The mixed turbine plant, therefore, gives excellent steam economy over wide ranges of load, it gives considerable elasticity of operation due to the fact that either engine or turbine may be operated separately. Any leakage in the engine due to leaky valves, and improper valve setting is taken care of by utilizing that steam in the turbine; and where exhaust steam is used for heating, the mixed turbine plant allows the required amount of heat to be diverted for heating purposes before the steam enters the turbine. The principal difficulty which must be solved in the practical design of mixed-flow turbines, is the method of regulation, so as to allow the use of all the exhaust steam available; after which any deficiency in the low pressure steam supply can be made up by high pressure steam. In order to obtain the proper efficiency of the turbine under the usual operating conditions, two methods are used.

The first consists of having a turbine so constructed that the high pressure steam is admitted automatically through an auxiliary high-pressure section of the turbine. In this case the high pressure steam goes through the high pressure portion of the turbine and after the steam has been expanded to practically atmospheric pressure, it enters the low pressure part of the turbine in which it expands down to the pressure in the condenser. When low pressure steam is admitted to the turbine it enters the low pressure section of the turbine only. When running as a low pressure turbine the high pressure blades will be revolving idly. The second method consists in utilizing high and low pressure steam on the same turbine wheels, the steam acting on the same buckets in both cases. The low pressure steam is admitted through one set of nozzles and the high-pressure steam through another set. The nozzles are so designed as to properly expand the steam from either source. Whichever system of steam distribution be used, it is very important that the piping be of proper design, and that both the engine and turbine units be protected by means of the proper safety devices, so that no damage be done, if the condenser flood, if the wrong valves are manipulated at the wrong time, or if the valves are not operated in their proper order when starting and stopping.



SWING GATE AND CHECK VALVE APPLICATION.

In order to allow the engine and turbine unit to operate safely under all conditions, the Nelson-Erwood Swing Gate and Check Valve has been designed and constructed. This acts as a safety valve on any pipe line where it is necessary that the flow through the pipe shall be in one direction and where disastrous effects would follow if the steam or condensate were allowed to flow into the engine or turbine in a direction contrary to that for which it was designed.

The general arrangement of piping for a mixed turbine and engine plant is shown in the accompanying illustration. When all the steam is used by the operating units, the steam flows from the boiler into the engine, then through the turbine and into the condenser.

If there be not enough exhaust steam coming from the engine to operate the turbine unit, live steam may be admitted to it as shown. If too much exhaust steam be flowing to the turbine, a portion of it may be diverted to flow into the feed water heater. Again a proper amount of exhaust steam may be used from the engine exhaust to supply the heating system when conditions require. Such a combination of piping as shown makes for flexibility of operation under all conditions of service.

The combined swing gate and check valves, when placed in their proper positions on the pipe, operate normally as an ordinary stop valve, but in addition they protect the power plant should conditions change without the knowledge of the operator. For instance, if the engine be started, without opening the valve on the exhaust, the swing gate check valve will open automatically at a predetermined back-pressure on the engine and stay open until it is mechanically closed by means of the hand-wheel attached to the valve stem as in ordinary gate valve. When the exhaust steam from the engine is used for the heating system, this swing gate and check valve is used on the atmospheric exhaust pipe as a back-pressure valve. With high pressure, any excess of pressure in the turbine, above the back pressure in the engine, is prevented from affecting the latter by the swing gate valve closing automatically. When the pressure on the turbine side decreases, the valve will allow the steam to flow to the turbine in the usual manner. As applied to the condenser piping, the swing-gate valve will prevent flooding of the turbine due to loss of vacuum and also acts as an atmospheric relief valve.

All of the protective and operating features of the swing gate valve are based upon the fact that it is constructed as a gate and check valve in one, and is capable of performing the functions of either. The checking action of the swing gate is controlled outside of the valve casing, according to the pressure desired, while the further action of the gate is controlled by the hand-wheel, which raises the gate above the valve opening exactly like an ordinary gate valve, thus giving a full unrestricted opening. The face of the gate and the seat ring are flat, both being made of bronze. The valve is always positive in its action, as the seat is constantly cleaned by the raising and lowering of the gate, which wipes or shears off any foreign matter which would otherwise interfere with perfect closing.

The Nelson Valve Co., Philadelphia, Pa., are the designers and builders of this swing gate and check valve.

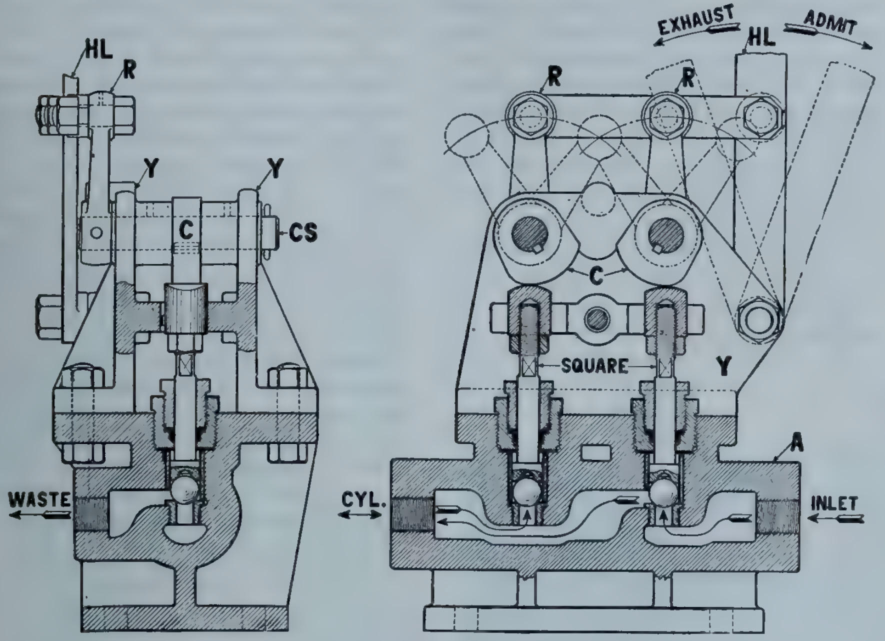
* * *

SCHNICKE HYDRAULIC OPERATING VALVES.

FROM time to time operating valves for hydraulic machinery have been designed and placed upon the market. In the Schnicke type the idea of a ball valve has been employed, which makes the operation very simple and reduces the chance to a minimum of any working part becoming damaged.

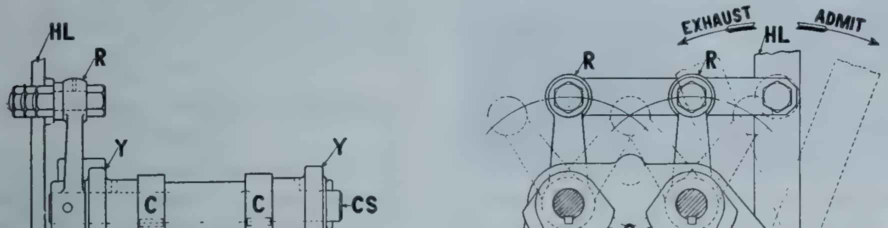
The valve is most easily described by referring to the accompanying cut. The horizontal valve chamber A is provided with pressure and waste ports and is machined to receive stuffing boxes, bushings and slot rings. To the top of the valve chamber are bolted the yokes Y, which form the bearings for the end of the cam-shafts, CS. To these cam-shafts are securely bolted the cams C, and the rocker arms R.

The cams are operated by the hand lever, H L, which is attached to the rocker arms. Seat rings of proper proportions are screwed into the pressure and waste ports of the valve chamber. Between the seat and the stem, a hard bronze ball is employed, the motion of which is controlled by the cam. The upper end of the stem is threaded into a bearing nut, and is also provided with a jam nut and square. These bearing nuts travel through a web in the yoke castings, while the lower part of the stems are held in position by the stuffing box glands and bushings; thereby ensuring proper alignment of the stems at all times. The cams are so designed and are keyed to the shaft in such a manner that when in operation the pressure port is closed before the waste port opens and vice versa.



SECTIONAL VIEW, SCHNICKE THREE-WAY HYDRAULIC OPERATING VALVE.

When the hand lever HL is thrown in the direction to admit the fluid under pressure the ball in the admission valve is forced off its seat and the fluid passes to the machine. To open the waste port, the hand lever HL is thrown in the opposite direction, and then the fluid escapes through the exhaust valve, which is opened by the fluid pressure in the machine. The square section on the valve stem, as well as the bearing nut and locking nut, being on the outside of the valve, are all readily accessible and permit of rapid and easy valve adjustment under working conditions. This allows the operator to keep his valves tight and thereby prevent leakage and to reduce repairs and upkeep to a minimum.



SECTIONAL VIEW, SCHNICKE FOUR-WAY HYDRAULIC OPERATING VALVE.

For pressures up to one thousand pounds, the bodies are made of air-furnace iron, and for pressures in excess of this, open-hearth steel or hydraulic bronze is used. The Schutte & Koerting Co., Twelfth and Thompson streets, Philadelphia, are marketing the above product in sizes from ¾ in. to 2½ in., and in three and four-way form with either screwed or flanged connections.

* * *

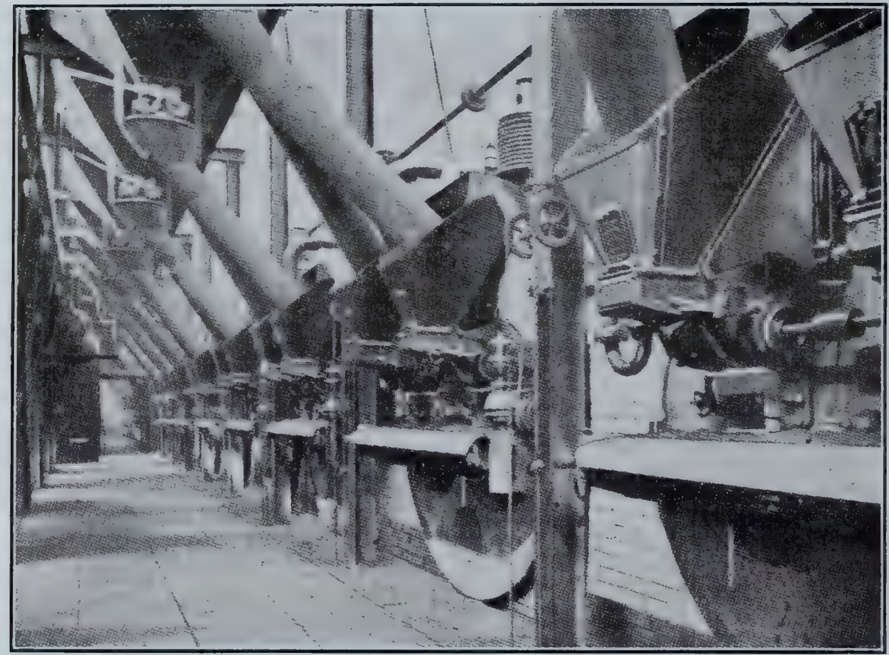
MACHINE-FIRING IN RAILWAY SYSTEM POWER STATION.

FORMBY power station is situated about half-way between Liverpool and Southport, England, close to the River Alt, thus ensuring a cheap and abundant supply of water for condensing purposes. Current is generated for the electric railway owned by the Lancashire & Yorkshire Railway Co. and links up Liverpool and Southport. The passenger traffic carried over this line in the course of a day is large, joining up as it does the important seaport shipping center with the residential seaside town of Southport. Trains follow each other in rapid succession from early morning until midnight in both directions and it will be understood that a delay on this section of the line would have serious results. It is thus very important that the principal factor in the power station, i.e., the steam-raising plant, should be maintained in a high state of efficiency and also be composed of units which after careful study have been found to be the most reliable under all conditions of working.

The Power Factor.

The power factor is necessarily an extremely variable quantity. At certain times of the day the trains are heavily laden and at other portions traffic is comparatively light. It is thus incumbent upon the officials to be certain that the steam-raising plant is highly flexible and that heavy peak loads may be easily taken when offered without imparing the efficiency of the line.

Coal is brought from collieries about twenty miles away, and is delivered by gravity from hopper wagons on to a bucket conveyor by which it is carried to overhead bunkers. From the bunkers, which hold about 130 tons, the coal is fed to the boilers by Bemis machine-stokers. The bucket conveyor, it may be mentioned, is also used for the disposal of the ashes. It should here be said that the boiler-room is 280 ft. long and 56 ft. wide and contains sixteen Lancashire type boilers. Each boiler is 32 ft. 6 in. long, 8 ft. 6 in. diameter, and has a grate area of 420 sq. ft., and 1,200 square feet of heating surface, with a normal evaporation of 12,000 lbs. per hour. The boilers are arranged in two batteries, north and south. The products of combustion on leaving each boiler pass through a superheater of 35 tubes, of 158 sq. ft. heating surface, and then go to the main flue, 10 ft. x 6 ft., which runs parallel to and against the wall between the engine-room and the boiler-room. The draught is induced by two fans 9 ft. 6 in. in diameter, one placed at each end of the main flue. Each fan has eight radial blades, being driven at a normal speed of 160 revolutions per minute by a compound vertical enclosed engine of 100 i.h.p. The products of combustion on their way to each fan pass through economizers, one being placed at each end of the flue. Each economizer consists of 720 tubes, 9 ft. long by 3 11-16 ins. internal diameter, embracing 7,200 square feet total heating surface.



BENNIS STOKERS IN A RAILROAD SYSTEM POWER STATION.

Steam is generated at a pressure of 160 lbs. per square inch, and passed from each boiler through a superheater formed of a nest of U tubes, giving 150 deg. F. superheat into the main steam range. Each battery is a complete unit in itself, having, as already intimated, an efficient set of economizers so as to utilize the heat in the waste gases. A separate fan and chimney distinguishes each battery. At the same time, the arrangement of the dampers renders it easily possible to run the whole of the boilers through either set of economizers to either chimney. The chimneys are of steel, about 50 feet high, and the draught is created by a fan, direct-coupled to a high speed engine. It is possible when the fan is working at full speed to produce a suction equal to 2 ins. water gauge at the outlet of the economizers.

Previous to the installation of mechanical stokers, the boilers were hand-fired and burning a good class **Burgy** coal, but the constantly increasing demands for steam became a serious problem. After careful inquiry and due consideration, the railway company decided to install mechanical stokers, and Edward Bennis & Co., Ltd., who are represented in Canada by G. H. Tod, Toronto and Winnipeg, were given instructions to fit eight of these boilers, that is, the whole of the south battery, with their latest type **sprinkler** stokers and self-cleaning compressed air furnaces.

The order was placed subject to severe and minute guarantees. Any or all of these boilers were to be capable of evaporating 14,000 lbs. of water per hour as from and at 212 deg. F. for twenty-four hours continuously if required, and for peak purposes 16,000 lbs. of water per boiler per hour for short duration. Under special conditions as to feed temperature, pressure, superheat, etc., and when burning ordinary Lancashire **slack**, the boilers, whilst evaporating the quantities of water stated above were not to exceed a coal consumption of 1,200 lbs. for each 10,000 lbs. of water evaporated. The steam and power required for the driving of the stokers, fan, engine, steam jets, was to be deducted before the total evaporation was recognized. Without the fan at work and with very little draught available, each boiler was to evaporate 10,000 lbs. of water per hour.

The tests were carried out in the presence of the company's officials, and the results were highly satisfactory and more than fulfilled the guarantee given. The water was measured in tanks, each holding 10,000 lbs. of water, carefully weighed and calibrated, previous to the test. The coal was weighed in trucks on the company's weighbridge which was guaranteed correct to 7 lbs.

The tests showed that the over-all efficiency was 81 per cent on the whole eight boilers and on a maximum evaporation test the evaporation per boiler per hour, from and at 212 deg. F. reached 23,000 lbs. The economical guarantees were satisfactorily fulfilled and the plant was then taken over by the company. It should be stated that the fuel was changed by adopting the stokers to a much cheaper grade, and also that the boiler capacity had been increased. After five months' operation, instructions were given to fit up the remaining battery of eight boilers with similar stokers.

During the period that elapsed between the fitting of the two batteries, several improvements in the throwing mechanism of the stokers were introduced by the patentees, and, as a consequence, the last eight boilers were fitted with the **balanced double shovel arm gear.** The plant was erected and tested, to the satisfaction of the officials of the company and taken over, and the improvements in the throwing mechanism having given satisfaction, the latter has been since applied to the first eight stokers installed.

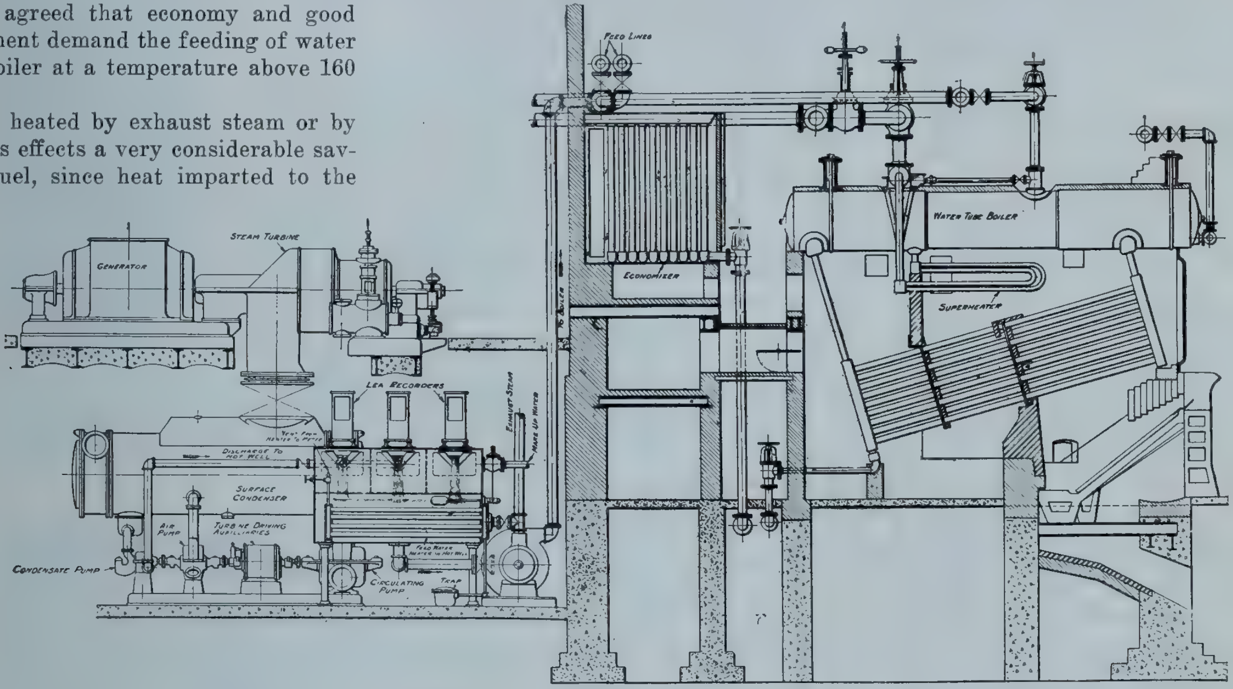
The boiler-house may now be considered as a scientific part of the whole generating plant. CO_2 recorders are installed, careful details kept of all particulars necessary to perfect combustion and efficiency, and test results have always been maintained, which fact is a credit alike to the stoker manufacturers and to those in charge of the plant operation.

RECORDING LIQUID METER APPLICATION.

IT is universally conceded that the fuel bill represents by far the largest expense in the operation of a power plant, manufacturing or otherwise. Of the heat units available from the 200,000,000 tons of coal burned each year under power plant boilers in the United States, it is estimated that almost fifty per cent. is wasted from one cause or another. Since the marketable supply of coal is steadily increasing in price, power plant and factory owners are awakening to a more thorough consideration of the fuel bills, and to apparatus designed to give information leading toward their reduction.

Until quite recently power plant measurements have been confined chiefly to the last and most efficient step in the transformation of heat units into horsepower, few plants of any size being unequipped with volt-meters, ammeters, steam engine indicators, etc. This, it would seem, however, is working upon somewhat the same principle as locking the door after the horse is stolen, since the greatest losses in economy occur long before the arrival of steam at the prime mover, the transformation of mechanical power into electricity, or indicated horse-power into shaft horse-power.

The plant owner of to-day is beginning to investigate and to install apparatus which will give him information about the evaporation of water per pound of coal, and the condensate coming from the prime mover—information which will enable him to effect a reduction in coal consumption, a greater efficiency in boiler operation, a more economical production and use of steam. These determinations all involve water measurements, in most cases hot water, since engineers are universally agreed that economy and good management demand the feeding of water to the boiler at a temperature above 160 degrees.



"LEA" RECORDING LIQUID METER APPLICATION.

Water heated by exhaust steam or by flue gases effects a very considerable saving in fuel, since heat imparted to the water in feed water heaters, or in fuel economizers, takes the place of an equivalent amount of heat that otherwise would have to be supplied from fuel on the grates. With a reliable and efficient means for keeping a continuous record of the consumption of boiler feed, condenser returns and make-up water, the owner or operator is enabled to determine many facts tending towards economy in that part of the plant where the greatest wastes generally occur. **In this connection,** the application of what is claimed to be an entirely successful recording liquid meter to a modern steam power plant equipped with fuel economizers and feeding water little below the boiling point, will be of interest to manufacturers, power plant owners and operators.

The accompanying drawing shows a boiler room containing standard type water tube boilers equipped with superheaters; the products of combustion discharging through economizers on the way to the stack. The engine room shown is equipped with horizontal turbine-driven generators using a typical surface condenser with turbine-driven air pump, condensate and circulating pumps. It is also equipped with a centrifugal turbine-driven boiler feed pump, which discharges into the economizers, the pump taking its feed water from the combined **Lea** V-notch meter, heater and hot well.

The combination of boiler feed meter, heater and hot well shown on this drawing is of particular interest, because of the application of the **Lea** V-notch meter to the measurement of the various elements going to make up the total boiler feed water. The drawing shows three V-notch meters built in and forming part of the hot well of the plant. The meter on the left receives the condensate from the turbine shown on the drawing and measures accurately the steam consumption of the generating set. The meter in the middle receives the condensate from turbine and surface condenser No. 2, while the third meter on the right is used for the measurement and control of the necessary make-up water. These three elements go to make up the total boiler feed water.

On the extreme right of the tank is shown a balanced control valve connected with the make-up water line. This valve is operated by means of a float and lever from the water level in the hot well below the meters, so that if there is not sufficient condensate coming back from the surface condensers to feed the boilers the water level in the hot well drops and in turn opens the make-up water valve. The feed pump draws its supply directly from the bottom of the hot well.

As it is desirable to have the feed water enter the economizers at an approximate temperature of 150 to 160 degrees in order to prevent sweating of the economizer tubes, and as the condensate leaves the condensers, under the best of conditions, at between 80 and 90 degrees F., and as the make-up water enters the hot well at a considerably lower temperature (usually dependent upon the outside or atmospheric temperature), it becomes necessary to introduce a heating element to raise the temperature of the boiler feed to the proper entering temperature for the economizers.

This condition has been met in the plant by introducing in the hot well of the meter a tubular heater, which receives exhaust steam from the boiler feed pump, or some other auxiliary. It will be noticed that this combination of meters, hot well and heater economizes floor space and gives a method of control of the elements entering into the boiler feed, both as to quantity and temperature, that is of great value to steam power plants using fuel economizers.

From the foregoing it would seem that the method outlined above, should produce very satisfactory results in steam plants equipped as described.

* * *

Vancouver, B.C.—Questions are being asked as to when the Public Service Corporation, which got a franchise from the city under certain conditions in March, 1913, is going to begin work in the city on its steam heating plant. Under the terms of the by-law, the Public Service Corporation was to spend $25,000 in the purchase of a plant within one year of the execution of the agreement, to lay and place in operation one mile of mains in the city within two years and operate two miles within two and one-half years.

Trade Gossip

Archibald Currie, city engineer of Ottawa, has placed his resignation in the hands of Mayor McVeity. Mr. Currie, who came to Ottawa from Westmount, has been incapacitated for some months through illness.

The Canadian Fairbanks-Morse Co., Ltd., Toronto, has supplied a complete equipment of transmission machinery with "Skefko" ball-bearings, to the Canadian Seamless Wire Co.'s new plant on Clinton Street, Toronto.

The Eugene Phillips Electrical Co. are making an extensive addition to their plant in Montreal, to cost in the neighborhood of $150,000. This extension when completed will practically double the capacity of the power and telegraph cable end of their business.

The Hare Engineering Co., Ltd., 78 Duchess Street, Toronto, manufacturers of mechanical stokers and power plant equipment, have appointed Frank Darling & Co., 1142-1144 Homer Street, Vancouver, B.C., as their British Columbia agents.

The Engineers' Supply Co., 123 Bannatyne Avenue East, Winnipeg, have been appointed agents in Western Canada for Belmont packings, manufactured by Clement Restim Co., Philadelphia. They are also agents for the Hill safety gauge glass.

Fraser & Chalmers of Canada, Ltd, Montreal, have received the following orders for "Terry" steam turbines:—One 46 h.p. turbine for driving turbine boiler feed pump, to the order of Escher Wyss & Co., Montreal; one 10 h.p. turbine for driving Lea-Courtenay volute pump for circulating water on compressor air coolers, for the Canadian Mining & Finance Co.; one 17 h.p. turbine for driving Thyssen air pump, and one 45 h.p. turbine for driving a Siemens' exciter set. The two latter turbine orders have been awarded by the Siemens Co., of Canada, the principal contractors. The machinery will be installed by the Britannia Mining and Smelting Co., Britannia Beach, B.C. They have also secured orders for one 20 h.p. turbine for driving a Siemens generator exciter from James Howden & Co., for Alberta University; one 125 h.p. turbine for driving a Lea-Courtenay pump for the town of Charlottetown, P.E.I.

Catalogues

How the Chief Engineer Was Convinced is the title of a booklet just published by the B. F. Sturtevant Co. of Canada, Ltd., Galt, Ont., which describes a visit of a prominent engineer to their works, and deals particularly with the manufacture of their turbines. It tells and illustrates how each part of the machine is made, tested and finished. Copies will be sent on request.

Wm. Geipel & Co., Glasgow, Scotland, have sent us a series of leaflets dealing with "Vulcan" rubber insulated cables, "Ringsdorf" carbon brushes, motor starters, "Geipel's" steam traps, "Okonite" tapes, etc. A comprehensive description is given of each product, together with complete price lists, while in some cases illustrations are included. Copies of the leaflet may be had on application.

"**Grinding**" is the title of a book just off the press, being distributed by the Lunkenheimer Co., Cincinnati, Ohio, and from whom copies may be obtained. The subject of grinding is dealt with in its relation to valves and their construction, with special regard to the valve seat which is designed to facilitate regrinding when worn. The text deals with the subject fully, and is accompanied by a number of sectional views showing the constructional features of the Lunkenheimer valves.

Undergrate Draft.—The Blaisdell-Canady Co., New York, has sent us bulletin No. 14 dealing with undergrate draft and its relation to higher efficiency and greater economy in the boiler room, with general reference to the "Canady" system of automatic furnace control. A number of illustrations are included of plants where the "Canady" system is installed, and also diagrams showing the method of application. Copies may be obtained from the company's Canadian representative, W. M. Campbell, Toronto, Ont.

Pressure Oil Filter—The V. D. Anderson Co., Cleveland, O., have sent us a catalogue devoted to their pressure oil filters. This catalogue will be interesting to superintendents and engineers, as it describes a new method of engine and machine lubrication. The important feature of this system is the "Anderson" pressure oil filter, each type being described fully with illustrations showing the interior construction and exterior arrangement. Two interesting diagrams are included showing a practical arrangement of the "Anderson" filtering apparatus used in a continuous flow system. Other products dealt with are filter pumps, storage and separating tanks, steam traps, and separators, etc. Price list and brief specifications are included for the above equipment.

Flow meters for measuring steam water and air are dealt with at length in a 52-page bulletin No. 46501, recently issued by the Canadian General Electric Co., Ltd., Toronto. The initial pages are devoted to the principle of operation of the G. E. Flow Meters and the service for which they are adapted. This is followed by a very complete description of the meters, illustrating and explaining the internal mechanism. Several tables are included giving velocity details for the nozzle plugs for the various types of meters, and also for pipe reducers when used with the plugs, with examples showing methods of selecting orifice tubes. Price lists are given for all sizes of the various types and complete order instructions are included.

Chain Grate Stoker.—Ed. Bennis & Co., Bolton and London, England, have issued an attractive 40-page catalogue devoted to an outline of the recent developments in the "Bennis" chain grate stoker. A description is given of the improved chain grate and links, followed by some interesting remarks on air spacing and draft. A distinctive feature of this catalog are the illustrations, which are exceptionally good, and show clearly the various points intended to be emphasized. The illustrations include views of smokeless chimneys, a number of installations of "Bennis" chain grate stokers, and several sectional views reproduced from drawings. Other interesting matter includes tabulated results of nine tests, a table giving the sizes of chain grate stokers, and a table of properties of saturated steam.

Book Reviews

"**Link Motion,**" by Fred H. Colvin, 101 pages, 45 illustrations. Published by Norman W. Henley Publishing Co., New York. Price 50c. net. This is the third edition, revised and enlarged, of a handy little book written with a view of explaining the mysteries of valve-setting. It also shows the different valve gears in use, explaining how they work, and for what purpose. Piston and slide valves of different types are illustrated and explained in a comprehensive manner. The book contains ten chapters devoted to locomotive link motion, valve movements, setting side valves, analysis by diagram, modern practice, slip of block, slide valves, setting piston valves, while the last chapter deals with other valve gears, such as Joy-Allen, Gooch, Allfree Hubbell, Walschaerts, the Baker and Southern. The illustrations in the first seven chapters consist principally of diagrams, carefully drawn, and explaining the text in a graphic manner. In chapter eight are shown various types of piston valves, while in the pages devoted to other valve gears, each type of motion is illustrated. The book is thoroughly practical, and no complicated problems have been introduced. The author has had wide experience, and is

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That is what a LIBERTY TUBE CLEANER will do for you. When the boilers are clean you get the FULL BENEFIT of your FUEL, and with clean boilers you get a large increase of power, and when that peak load comes on your boilers will easily handle it.

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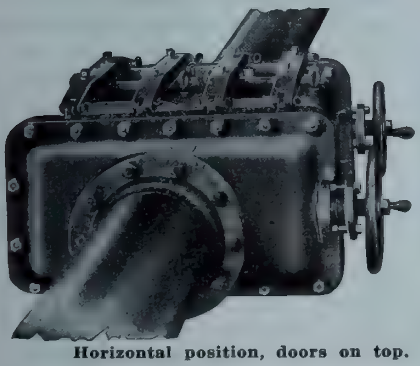

Horizontal position, doors on top.

Do your condenser tubes become clogged with rubbish?

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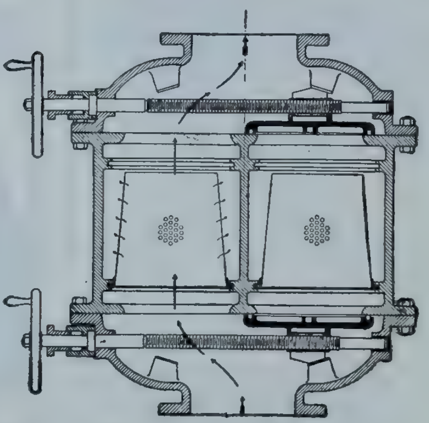

Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

City of Moose Jaw

Tenders for

STEAM PIPE

Sealed Tenders marked "Tenders for Steam Pipe" and addressed to the City Commissioners, Moose Jaw, Sask., will be received up till 12 o'clock (noon) on Wednesday, August 26th, 1914, for High Pressure Steam Pipe and Appliances for a 3,500 horse power plant.

Plans and specifications may be obtained upon application to J. D. Peters, Elec'l Supt., Moose Jaw.

The lowest or any tender not necessarily accepted.

Jas. Pascoe,
Geo. D. Mackie,
W. F. Heal,
City Commissioners.

Moose Jaw, July 28th, 1914.

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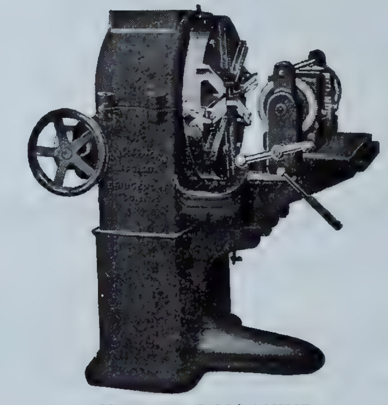

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Door Arches and Whole Front in one block.

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These linings do not expand or contract and there are no bricks or mortar joints to work loose.

They are readily installed by anyone and require no special molds or forms. Let us tell you how.

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perfectly at home with his subject. The book, which is pocket size, will be a most useful addition to the library of the young engineer interested in locomotive construction.

Electric Wiremans' Work, by J. H. Havelock, 319 pages and appendix. 100 illustrations and numerous tables. Published by Crosby Lockwood & Son, London, England. Price 5s. ($1.25) net. This is a practical handbook for installation inspectors, electricians, wiremen, students and others engaged in the electrical trades. The author assumes that the reader is familiar with the principles of magnetism and electricity, and has a working knowledge of practical mathematics. At the same time the requirements of the student have been constantly kept in view throughout the book, which does not limit its sphere of usefulness, as the subject matter is treated both theoretically and practically. The volume is divided into three sections devoted to wiring calculations, theory and practice of electric wiring and drawing respectively. Section one deals principally with units, conductors, work and power, energy and illumination, with a chapter on miscellaneous calculations. Section two deals with conductors, meters, fuses, lamps, accessories. dynamos, motors, batteries, wiring and bells. Section three contains two chapters on drawing and several pages of miscellaneous problems and logarithms. The concluding pages are devoted to two appendices, the first consisting of nine tables containing a fund of valuable data for electricians. The second appendix gives the wiring rules for the Institution of Electrical Engineers, Lloyd's rules for wiring and tables of logarithms. The book is fully illustrated, which combines to make it a very useful volume and one of which no student or electrician, at all familiar with his work, should have any difficulty in mastering the contents.

"**Oil Fuel for Steam Boilers,**" by Rufus T. Strohm, 139 pages, 63 illustrations. Published by the McGraw-Hill Book Co., New York, price $1. This is the first edition of a volume forming one of the latest additions to the series of "Power" handbooks. It has been written with the view of describing, in clear and simple language, the principles that underlie the use of oil as a fuel in steam boiler practice. No attempt has been made to describe the use of oil in locomotive or marine practice or in heating, tempering, or hardening furnaces, because, as the author says in the preface, these applications are so extensive as to deserve individual treatment. The material is a compilation of the available information on the subject of oil burning, and was obtained to a large extent from catalogues, and from various technical publications issued during the past ten years. The book contains fourteen chapters, all dealing with oil fuel, and its application to steam boilers. The subjects covered include the properties of oil fuel, requirements for efficient burning, methods of spraying, burners, cleaning oil fuel, pumping and heating, oil burning furnaces, installations of burners, storage and combustion, management of plants, purchasing of oil fuel, advantages and disadvantages of oil fuel and performances of oil burning boilers. The illustrations include various types of oil burners and other appliances, also views of boilers showing the application of oil burning apparatus. Five tables are included, containing much useful data on the subject. This is essentially a practical book containing a great deal of valuable information for engineers and students. The author is the engineering text book writer for the International Correspondence Schools at Scranton, Pa.

Steam Heating.—The Harrison Safety Boiler Works, Philadelphia, Pa., have recently put forth for distribution their new 207-page edition of the "Exhaust Steam Heating Encyclopedia," which, without question, will be a valuable addition to the library of any engineer. It contains much valuable information on the use of exhaust steam for heating, the result of many years of careful study of the proposition. The book illustrates and describes in a general way twenty-eight different commercial systems of exhaust steam heating, showing at the same time the application of the new "Cochrane" steam stack and cut-out valve heater to these heating systems, for which the book was primarily intended. The "Cochrane" steam stack and cut-out valve heater, illustrated and described, contains the latest improvements in the design and construction of the open type feed water heater, especially where used in connection with steam systems. This volume also contains the special application of the "Cochrane" steam stack and cut-out valve heater for use with heating systems, also in connection with condensing plants and low pressure steam turbines and ice and refrigerating plants. Another feature taken up is the application of the "V" notch weir for the measurement of hot boiler feed water, combining the meter with the feed water heater, into a metering heater. It also contains a description of the "Cochrane" multiport safety exhaust outlet valve for the absolute control of the pressure and exhaust steam heating and drying systems. Tables and information relating to exhaust steam heating, data on temperatures and heat losses, valuable tables on the properties of air and steam, heat transmission for low pressure steam, to-

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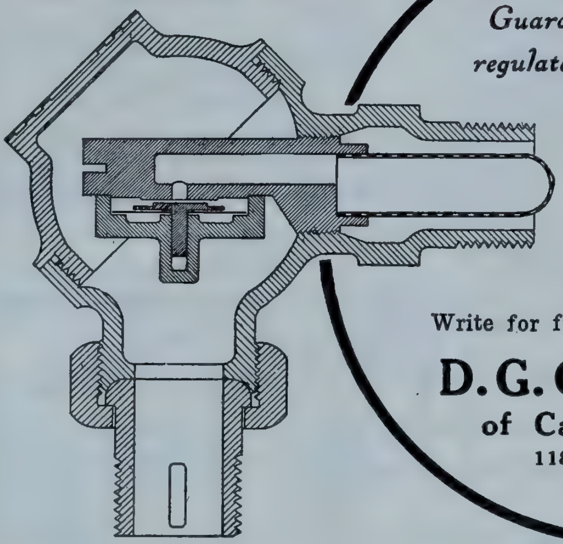

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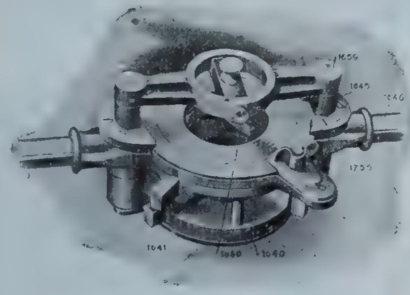

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It starts itself on the pipe and automatically throws itself out after a Briggs Standard Thread is cut, instead of backing off, which spoils the dies.

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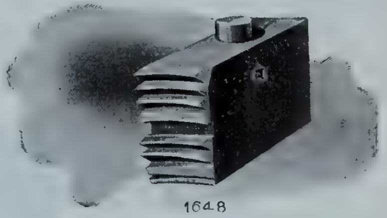

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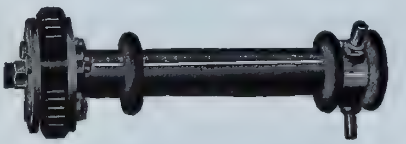
For boilers with large water spaces of all kinds.

For the removing of Rust and so on.

For sharpening of millstones.



For water tube boilers of all kinds, economizers, apparatuses vacuum, and so on.

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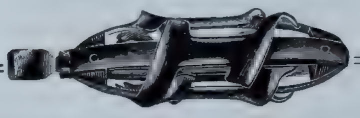

gether with data for hot water heating with forced circulation, are also contained in this edition. Canadian Allis-Chalmers, Ltd., Toronto, as the sole agents for "Cochrane" apparatus, have received a supply of these catalogues for distribution among the engineers, and same can be had from them on application.

Fuel Economy and CO_2 Recorders, by A. R. Maujer and Charles H. Bromley, 190 pages, 28 illustrations. Published by McGraw-Hill Book Co., New York. Price, $1.50 net. The work is largely made up of the lessons on combustion which first appeared in the Engineers' Study Course carried out in **The Power** magazine. When preparing these lessons, the aim of the authors was evidently to present the subjects treated in a manner easily understandable to the engineers and firemen who have to do with the final use of the fuel, and on whom depend how economically it shall be used. A strong point is made to the effect that a high-class technical education is not required by the fireman in order to understand the theory of perfect combustion and to apply such knowledge to the conserving of his own labor and to getting the most out of the coal. The book begins with a simple presentation of the theory of combustion, including the chemical elements connected therewith, and gives a clear idea of arriving at the amount of air required for combustion. The several methods of coal analysis are explained with the end in view of enabling the engineer to accurately determine the heating value of the coal he may have to deal with. In the chapter dealing with flue gas analysis the "Orsat" method is thoroughly described, and valuable advice is given in the selection and cost of the necessary apparatus. From this the reader is directed to the estimating of the heat losses in the flue gases, the measurement of draft and some practical calculations relating to chimney dimensions. Beginning with chapter seven, the subject of evaporation is dealt with, and the disposition of the heat used in the process is explained. Following this, is given a concise description of the different boiler tests and the compiling of the heat balance. The treatment of feed water is largely denuded of its chemistry, and put on a fractional basis and the mysteries of the CO_2 recorder, long out of the reach of the average power plant operative, are clearly explained. The authors are both practical men. The arrangement of the different chapters has done much to simplify the subject and make it attractive, while the whole deals with those matters with which the operative is directly concerned.

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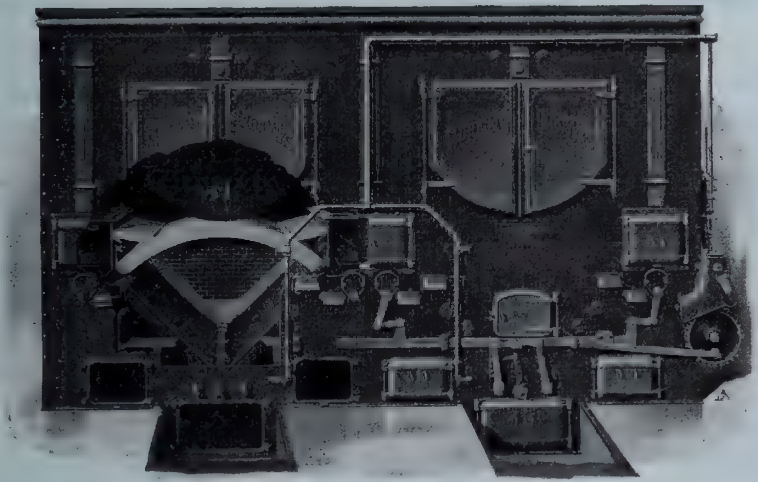

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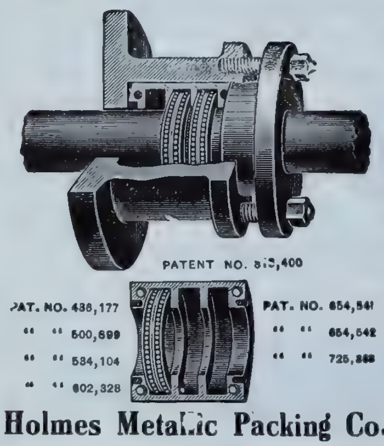

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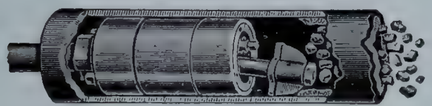
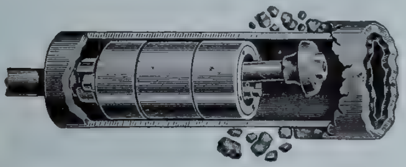


The Dean removing scale from the tube of a water-tube boiler.



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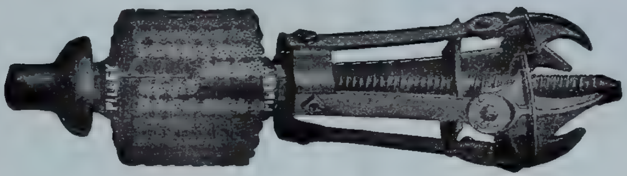

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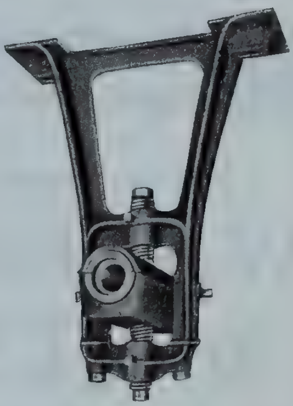

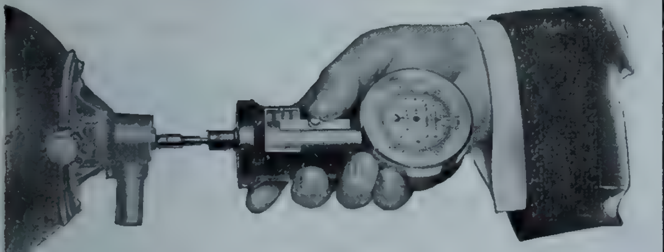

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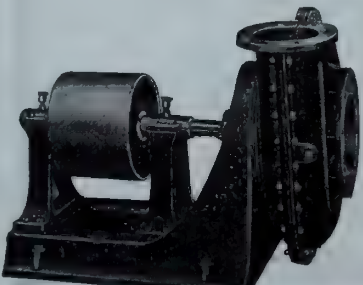

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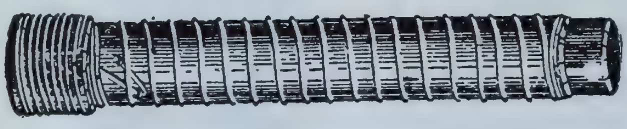

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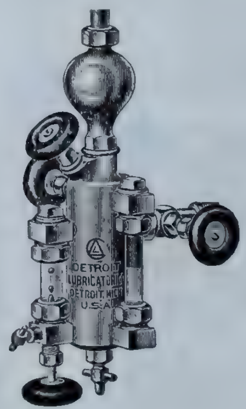

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REMEMBER we guarantee it to save 50% over any other system.

Give it a trial and be convinced.

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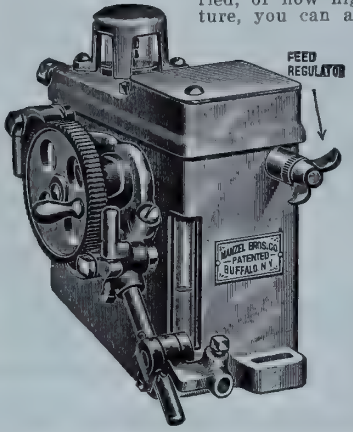
will give you efficient lubrication at
A 50 PER CENT. SAVING IN OIL

No matter how slow your engine runs, what pressure of steam is carried, or how high or low the temperature, you can adjust the Manzel Sight Feed Oil Pump so as to give the right amount of lubrication—not a drop more or less.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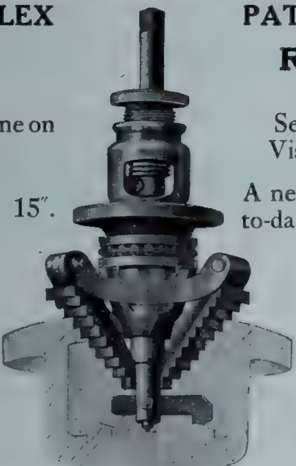
A necessity in an up-to-date Power Plant.

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Faces Valves with Flat or Angled Seats



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No Waste Ends or Dried-out Packing.
Will Not Burn Out or Bind the Rod.
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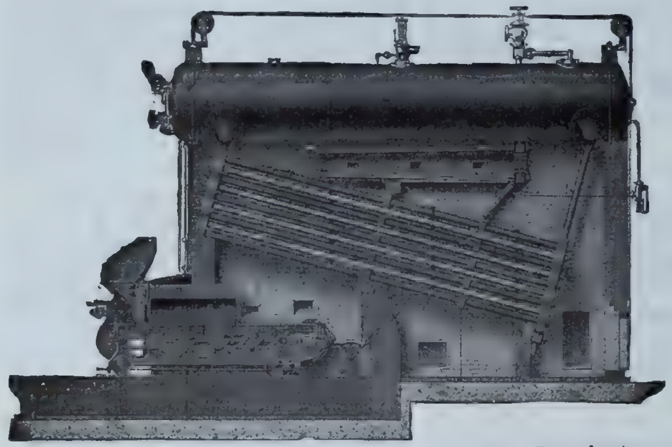

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Canadian Griscom-Russell Co., Ltd., Montreal.
John McDougall Caledonian Iron Works, Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.
Theodore Kipp Co., Winnipeg.

Fire Extinguishers and Fire Alarm Apparatus.
Northern Electric Co., Ltd., Montreal.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick and Clay.
Betson Plastic Fire Brick Co., Rome, N.Y.
Ideal Incinerator Co., Toronto.

Fire Box Blocks.
Betson Plastic Fire Brick Co., Rome, N.Y.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flue Blowers.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.

Flue Gas Analysis Instruments.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnaces.
John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert.

Furnace Linings and Arches.
Betson Plastic Fire Brick Co., Rome, N.Y.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.

Fuses, Renewable.
Economy Fuse & Mfg. Co. of Canada, Montreal.

Gas Analysis Instruments, Etc.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gaskets, Rubber, Asbestos, Lead and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Durabla Mfg. Co., New York.
Frick Co., Waynesboro, Franklin Co.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.

Gas Producer Plants.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene and Oil Storage and Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges, Ammonia, Oil, Gas, Air.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Gears, Cut, Worm, Mortise.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

Generators and Convertors.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Griscom-Russell Co., New York.
Siemens Co. of Canada, Ltd., Montreal
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Northern Electric Co., Ltd., Montreal.

Gongs.
Northern Electric Co., Ltd., Montreal.

Governors, Water Wheel.
W. H. Allen Son & Co., Bedford, Eng.
Can. Allis-Chalmers, Ltd., Toronto.

Graphite, Boiler.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Graphitol.
C. C. Snowdon, Calgary.

Grates
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.

Grease Cups.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.

Greases.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Theodore Kipp Co., Winnipeg.
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Nobis Engineering Co., Toronto.
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Herbert Morris Crane & Hoist Co., Ltd., Toronto.
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Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
W. H. Allen Son & Co., Bedford, Eng.
John Inglis Co., Ltd., Toronto.
John McDougall Caledonian Iron Works, Montreal.
Nobis Engineering Co., Toronto.

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Bawden Machine Co., Toronto.

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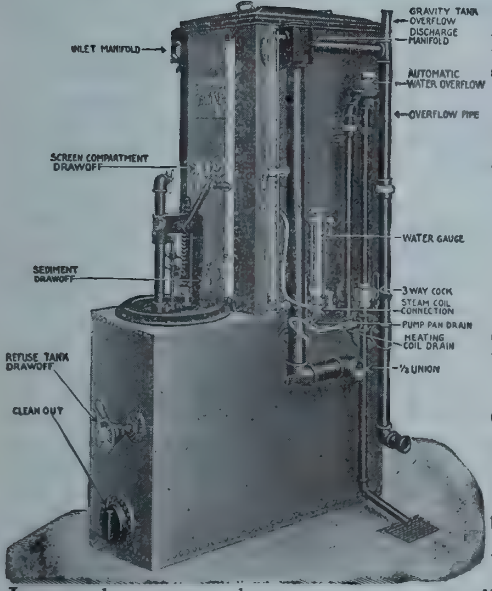
SOLE AGENTS

PEACOCK BROTHERS

Montreal Vancouver

Saving Oil the Bowser Way



Look, again, at that picture. It shows the "workings" of part of a Bowser Oil Filtering and Circulating System. It insures greater oil efficiency at least outlay.

The picture shows the Separator and Refuse Tank disconnected from the balance of the system. The marginal notes make it all clear. The tank contains only the clarifying devices through which the oil must pass to be filtered.

BOWSER ESTABLISHED 1885 OIL CLARIFYING SYSTEMS

A Bowser Oil Clarifying System enables you to control your oil expenditure, and to *know* where the money goes. It means "sweeter" running equipment--no part neglected or "swamped."

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During thirty years, the Bowser idea has grown until today there are over 500 different Bowser systems—a million users. Among the 500 is just the equipment for you. Let us tell you about it. Tell us something of your plant. Ask questions. Let us show you where you can save oil, time and money, and increase the efficiency of your engine room the *Bowser* way. It costs nothing to find out. Involves no obligation. Write today—NOW.

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Engineers, Manufacturers and Original Patentees of Oil Handling Devices

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- John Inglis Co., Ltd., Toronto.
- York Mfg. Co., York, Pa.

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- Geo. H. Tod, Toronto.
- Northern Electric Co., Ltd., Montreal.

Indicators Electric—All Types.
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- Can. Westinghouse Co., Hamilton.
- Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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- Ideal Incinerator Co., Toronto.

Indicators, Steam and Gas Engine.
- Can. Fairbanks-Morse Co., Montreal.

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- Jas. Morrison Brass Mfg. Co., Toronto.
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- Canadian General Electric Co., Ltd., Toronto.
- Can. Sunbeam Lamp Co., Toronto.
- Northern Electric Co., Ltd., Montreal.

Lamps, Arc, Incandescent.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian Westinghouse Co., Hamilton
- P. H. Klein, Jr., Co., Montreal.
- Northern Electric Co., Ltd., Montreal.

Lubricants.
- Can. Oil Companies, Ltd., Toronto.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.
- Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
- Darling Bros., Montreal.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.
- Manzel Bros. Co., Buffalo, N.Y.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.

Magnetos.
- Northern Electric Co., Ltd., Montreal.

Mechanical Stokers.
- Babcock & Wilcox, Montreal.
- Ed. Bennis & Co., Little Hulton, Bolton, Eng.
- Jones Underfeed Stoker Co., Toronto.
- Murphy Iron Works, Detroit, Mich.
- Geo. H. Tod, Toronto.

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- American Pulley Co., Philadelphia.

Meters, Electric.
- Can. British Eng. Co., Winnipeg.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton.
- Monarch Electric Co., St. Lambert, Que.
- Siemens Co. of Canada, Ltd., Montreal

Meters, Steam.
- Nobis Engineering Co., Toronto.

Meters, Water.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Siemens Co. of Canada, Ltd., Montreal.

Mica.
- Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- Can. Fairbanks-Morse Co., Montreal.
- Jenckes Machine Co., Sherbrooke, Que
- International Engineering Works, Ltd., Amherst, N.S.
- Goldie & McCulloch Co., Galt.
- Theodore Kipp Co., Winnipeg.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.
- Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
- Bawden Machine Co., Toronto.

Motors.
- W. H. Allen Son & Co., Bedford, Eng.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Northern Electric Co., Ltd., Montreal.
- Siemens Co. of Canada, Ltd., Montreal.

Motor Starters and Controllers.
- W. H. Allen Son & Co., Bedford, Eng
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- Can. Westinghouse Co., Hamilton.
- Siemens Co. of Canada, Ltd., Montreal.

Office Railings.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.

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- Darling Bros., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Heaters and Coolers.
- Griscom-Russell Co., New York.

Oil Separators.
- Babcock & Wilcox, Montreal.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Canadian Griscom-Russell Co., Ltd., Montreal.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Liberty Mfg. Co., Pittsburg.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Smart - Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
- S. F. Bowser & Co., Inc., Toronto.
- Theodore Kipp Co., Winnipeg.
- Lunkenheimer Co., Cincinnati, O.

Oils, Lubricating.
- Can. Oil Companies, Ltd., Toronto.
- McColl Bros. & Co., Winnipeg, Man.
- C. C. Snowdon, Calgary.

Packing, Engine.
- Can. Gasket Co., Bridgeburg, Ont.
- Can. H. W. Johns-Manville Co., Toronto.
- Garlock Packing Co., Hamilton, Ont.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Hydraulic.
- Greene, Tweed & Co., New York.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Packing, Metallic.
- Holmes Metallic Packing Co., Wilkesbarre, Pa.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
- Goetze-Gasket & Packing Co., New Brunswick, N.J.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Garlock Packing Co., Hamilton, Can.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Sheet.
- Canadian Consolidated Rubber Co., Ltd., Montreal.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Jenkins Bros., Ltd., Montreal.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
- Canadian H. W. Johns-Manville Co., Toronto.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Greene, Tweed & Co., New York.
- Nobis Engineering Co., Toronto.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
- Graton & Knight Mfg. Co., Worcester, Mass.

Patents.
- Rowland Brittain, Vancouver, B.C.

Penstocks.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.

Pillow Blocks.
- Can. Bond Hanger & Coupling Co., Alexandria.
- Elmira Machinery & Transmission Co., Elmira, Ont.

Pipe Bending.
- Nobis Engineering Co., Toronto.

Pipe Coils.
- National Pipe Bending Co., New Haven, Conn.
- York Mfg. Co., York, Pa.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
- Oster Mfg. Co., Cleveland, O.

Pipe Steel.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.

Pipe (Second-hand).
- Imperial Waste & Metal Co., Montreal.

Pipes, Water.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Pacific Coast Pipe Co., Vancouver, B.C.

Piping and Fittings.
- Frick Co., Waynesboro, Franklin Co. Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.
- York Mfg. Co., York, Pa.

Piping, Steam.
- Babcock & Wilcox, Montreal.
- Imperial Waste & Metal Co., Montreal.

Plate Work.
- Can. Allis-Chalmers, Ltd., Toronto.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que.
- Waterous Engine Works Co., Brantford.

Pneumatic Chain Blocks.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Polish, Metal.
- G. W. Hoffman, Indianapolis.

Power Pumps.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- Goldie & McCulloch Co., Galt.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Waterous Engine Works Co., Brantford.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
- American Pulley Co., Philadelphia.
- Can. Bond Hanger & Coupling Co., Alexandria, Ont.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery & Transmission Co., Elmira, Ont.
- Goldie & McCulloch Co., Galt.
- Jeffrey Manufacturing Co., Columbus.
- Jenckes Machine Co., Sherbrooke,
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Waterous Engine Works Co., Brantford.
- Siemens Co. of Canada, Ltd., Montreal.

Presses.
- John Inglis Co., Ltd., Toronto.

Pulleys.
- American Pulley Co., Philadelphia.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery and Transmission Co., Elmira, Ont.
- Jeffrey Manufacturing Co., Columbus.
- Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- Escher, Wyss & Co., Toronto.
- Jeffrey Manufacturing Co., Columbus.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.

Pumping Machinery.
- American Steam Pump Co., Battle Creek, Mich.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- Bawden Machine Co., Ltd., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
- W. H. Allen, Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Jeffrey Manufacturing Co., Columbus.

Pump Governors and Regulators.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- G. M. Davis Regulator Co., Chicago, Ill.
- Elliott Co., Pittsburgh, Pa.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Watson & McDaniel Co., Philadelphia.

Pump Strainers.
- Canadian Steam Boiler Equipment Co., Toronto.
- Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
- W. H. Allen Son & Co., Bedford, Eng.
- American Steam Pump Co., Battle Creek, Mich.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Contractors'.
- W. H. Allen Son & Co., Bedford, Eng.
- William Hamilton Co., Ltd., Peterborough.

Pumps, Hand and Power.
- S. F. Bowser & Co., Inc., Toronto.

Pumps, Centrifugal.
- Boving & Co., of Canada, Limited, Toronto.
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- Bromell Patents Co., Ltd., Glasgow, Scotland.
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- Engineering Works of Canada Ltd., Montreal.
- Canadian Boving Co., Toronto.
- Escher, Wyss & Co., Toronto.
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Works, Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Theodore Kipp Co., Winnipeg.
- Turbine Equipment Co., Toronto.
- Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
- American Steam Pump Co., Battle Creek, Mich.
- The Bawden Machine Co., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Hydraulic, Pressure.
- American Steam Pump Co., Battle Creek, Mich.
- Bawden Machine Co., Ltd., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- John Inglis Co., Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Pump Leathers.
- Graton & Knight Mfg. Co., Montreal.

Pumps, Oil.
- The Bawden Machine Co., Toronto.
- S. F. Bowser & Co., Inc., Toronto.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.
- Manzel Bros. Co., Buffalo, N.Y.
- Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Steam.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- S. F. Bowser & Co., Inc., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Goldie & McCullough Co., Galt.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Pumps, Triplex.
- William Hamilton Co., Ltd., Peterborough.

Pumps, Vacuum.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- C. A. Dunham Co., Toronto.
- John Inglis Co., Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.

Pump Tank, Receiver.
- American Steam Pump Co., Battle Creek, Mich.
- Can. Allis-Chalmers, Ltd., Toronto.

Pyrometers.
- Jas. Morrison Brass Mfg. Co., Toronto.

Rails (Relaying).
- Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
- Jas. Morrison Brass Mfg. Co., Toronto.

Railway—Industrial.
- C. W. Hunt Co., New York.

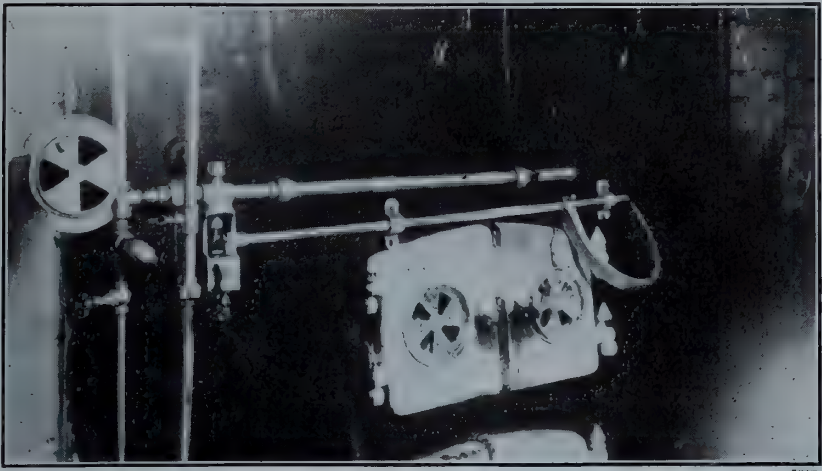
Reboilers.
- Frick Co., Waynesboro, Franklin Co., Pa.

Recording Instruments.
- Northern Electric Co., Ltd., Montreal.
- Theodore Kipp Co., Winnipeg.

Reels.
- American Pulley Co., Philadelphia.

Refrigerator Doors, Windows, etc.
- Jones Cold Store Door Co., Hagerstown, Md.

Refrigerating Engineers.
- Arctic Ice Machine Co., Canton, Ohio.
- Chas. Bishop, Montreal.



GIBBONS-KEMP

Oxygen Fuel System

Consists of a series of coned devices built into the side walls, bridge wall and front of boiler setting. The object is to mingle heated oxygen with the gases, when liberated from the fuel, and by so doing we get perfect combustion. A current of air is taken from the front of the boiler and passes along the coned side devices three times before it is delivered to the fire.

A current of air is also passed into a coned device placed within the bridge wall. Also a small steam jet, taking about one per cent. of the boiler capacity, is passed through the superheater, placed in front of the boiler setting, and is used only as a force for the purpose of mingling the oxygen with the carbon gases during firing.

An automatic valve, as shown in cut, is used to control the steam jet, which opens when the fire door is opened, and closes from thirty seconds to five minutes after the door is closed, and can be timed to suit the quality of coal used. Pre-heated air is used for draft, effecting the same economical results as the feeding of heated water in place of cold to the boiler. All heat used for pre-heating the oxygen and draft is waste heat, and therefore takes nothing from the efficiency of the boiler.

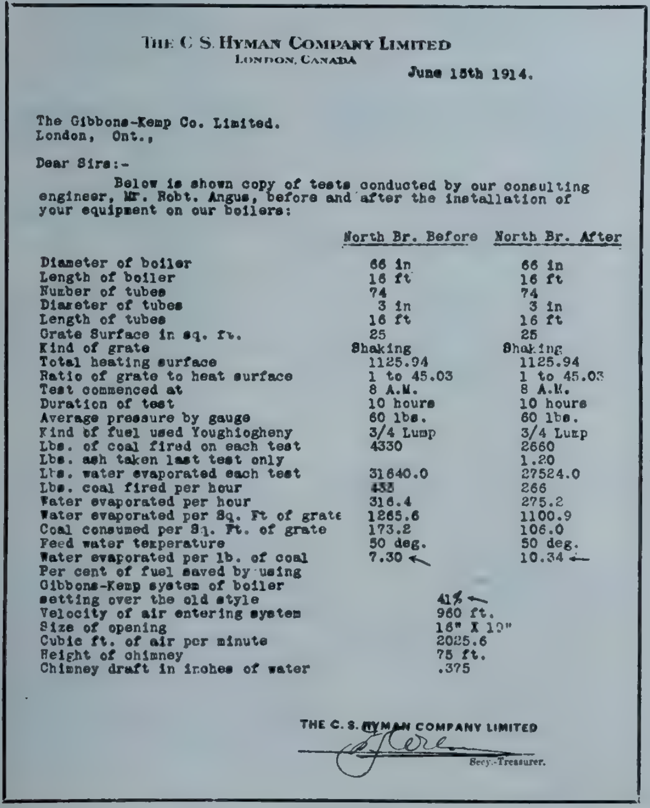
No force draft is used—the whole system being perfectly automatic, and although an intense heat is generated, it is distributed evenly over the full length of the boiler. No machinery is used in this installation, so there is nothing to get out of order to cause expensive repairs. The first cost is the only cost, and provided the fire lining is kept in repair, which has to be done in any case, our installation will last the life of the boiler.

This is the only system whereby you will get full 80% efficiency from your coal.

We guarantee a 15% saving in fuel, regardless of the quality of fuel, or whether it be coal, coke or wood, and guarantee to eliminate the smoke nuisance. If we do not produce these results we ask no pay.

Opposite is a reproduced report of an unbiased test made by C. S. Hyman Co., Limited, of London, Ont., after our installation was made.

Further particulars and list of other plants equipped, with copies of boiler tests, on request.



THE C. S. HYMAN COMPANY LIMITED
LONDON, CANADA

June 15th 1914.

The Gibbons-Kemp Co. Limited.
London, Ont.,

Dear Sirs:-

Below is shown copy of tests conducted by our consulting engineer, Mr. Robt. Angus, before and after the installation of your equipment on our boilers:

	North Br. Before	North Br. After
Diameter of boiler	66 in	66 in
Length of boiler	16 ft	16 ft
Number of tubes	74	74
Diameter of tubes	3 in	3 in
Length of tubes	16 ft	16 ft
Grate Surface in sq. ft.	25	25
Kind of grate	Shaking	Shaking
Total heating surface	1125.94	1125.94
Ratio of grate to heat surface	1 to 45.03	1 to 45.03
Test commenced at	8 A.M.	8 A.M.
Duration of test	10 hours	10 hours
Average pressure by gauge	60 lbs.	60 lbs.
Kind of fuel used Youghiogheny	3/4 Lump	3/4 Lump
Lbs. of coal fired on each test	4330	2660
Lbs. ash taken last test only		1.20
Lbs. water evaporated each test	31640.0	27524.0
Lbs. coal fired per hour	433	266
Water evaporated per hour	316.4	275.2
Water evaporated per Sq. Ft of grate	1265.6	1100.9
Coal consumed per Sq. Ft. of grate	173.2	106.0
Feed water temperature	50 deg.	50 deg.
Water evaporated per lb. of coal	7.30 ←	10.34 ←
Per cent of fuel saved by using Gibbons-Kemp system of boiler setting over the old style	41% ←	
Velocity of air entering system	960 ft.	
Size of opening	16" X 10"	
Cubic ft. of air per minute	2025.6	
Height of chimney	75 ft.	
Chimney draft in inches of water	.375	

THE C. S. HYMAN COMPANY LIMITED
Secy.-Treasurer.

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London, Ont.

Branch Office : 53 Yonge St., Toronto, Ont.

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Linde Canadian Refrigeration Co., Montreal.
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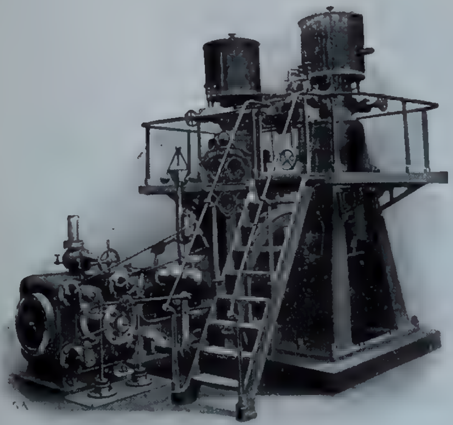

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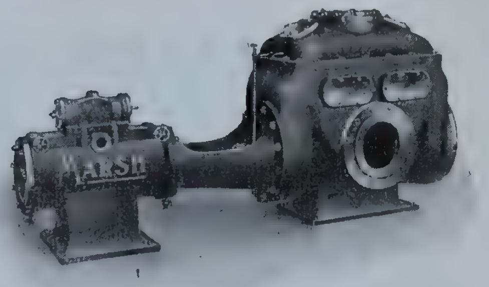

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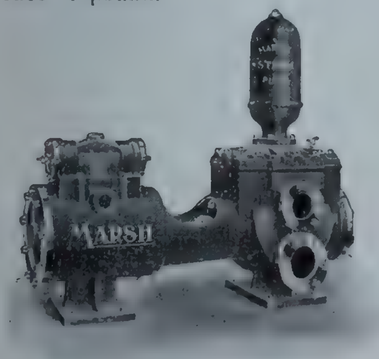

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Every pound reduction in pressure that you can make saves a certain amount of fuel. In most plants there are many places where less than boiler pressure can be used, and steam saved, if proper use is made of the

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Here is a device that saves steam and works automatically. You simply set it to make delivery at the required pressure and no matter what the boiler pressure may be or how much it varies, the Davis Regulator will maintain a constant reduced pressure.

This valve is simple in construction—it does its work well and it lasts. Tell us your needs and we will let you have a valve to test in your own plant. If not satisfactory in every respect, return it and you will be under no obligations to us.

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High-Pressure Condensing

High-Pressure Non-Condensing

Exhaust Steam Low Pressure

Bleeder Type Low Pressure

A 10,000 k.w. Westinghouse High-Pressure Steam Turbine

There is a Westinghouse Steam Turbine especially designed to meet your requirement

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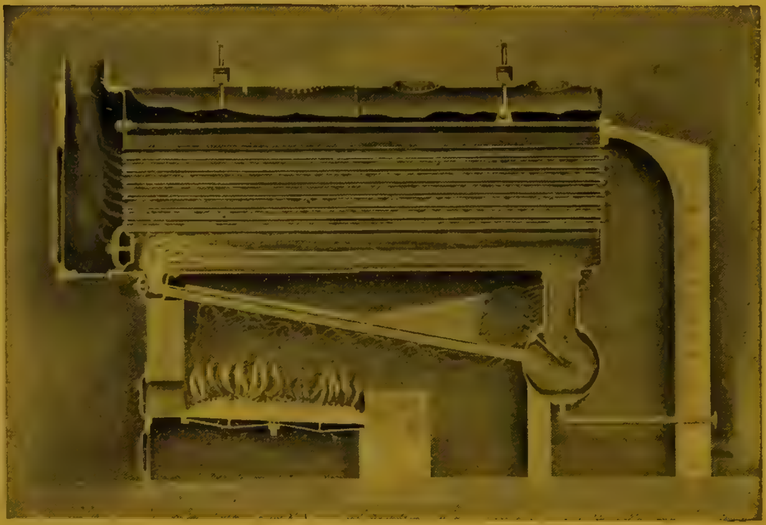
A combination of fire and water-tube construction

On account of the perfect circulation and combustion, the boiler, with normal draft, will evaporate 11 lbs. of water to 1 lb. of coal.

At the rear of the boiler there will be noticed a large drum, designed to take care of the mud and scale. As the water circulates down the back connection, mud and other sediment will collect in the bottom of this drum and can be blown off at the engineer's convenience. The drums are so built that there are no hand holes or plugs in the fire.

See Bulletin 510

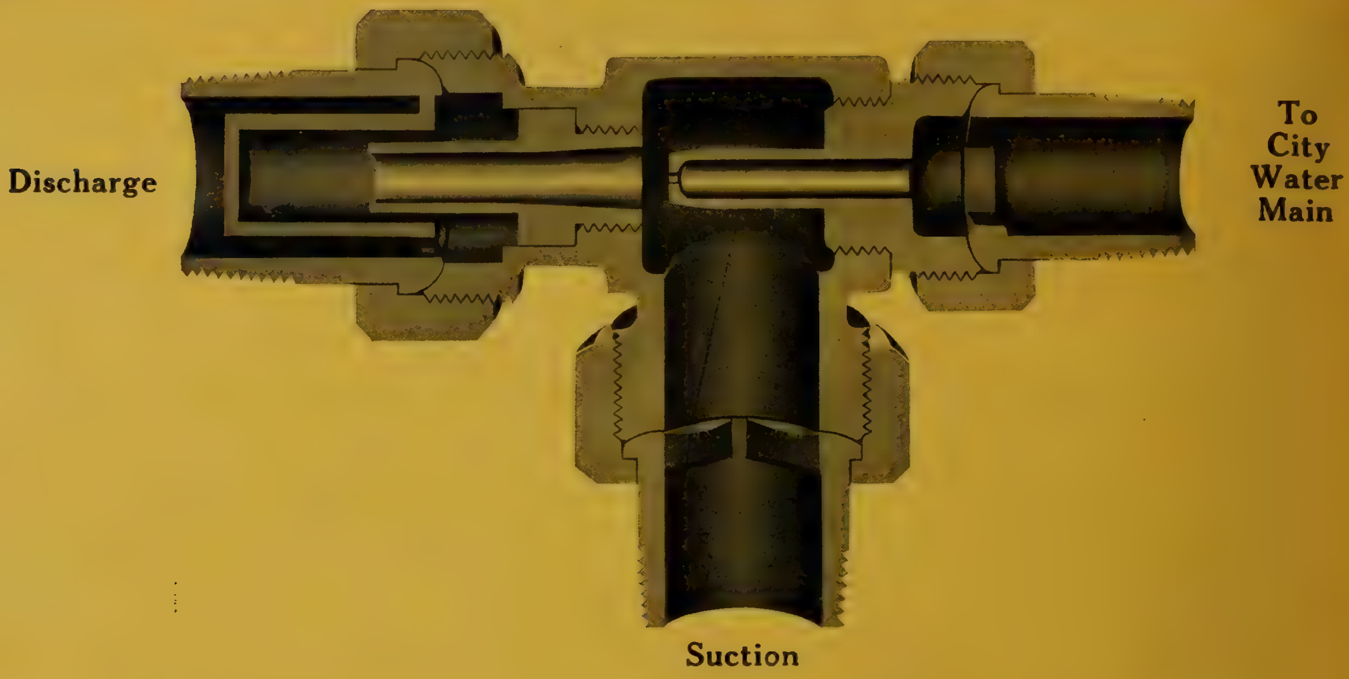


CANADIAN ALLIS-CHALMERS, LIMITED

Manufacturers of Air Compressors, Avery Scales, Boilers, Cement-Making Machinery, Concrete Mixers, Flour Mill Machinery, Gas Engines, Hoisting Engines, Hydraulic Machinery, Lidgerwood Engines and Cableways, Locomotives, Logging Machinery, Mining and Crushing Machinery, Ornamental Metal Work, Rock Crushers, Rock Drills, Saw Mill Machinery, Steam Pumps, Steam Shovels, Steam Specialties, Steam Turbines, Structural Steel, Transmission Machinery, Turbine Pumps, Water Pipe, Water Wheels.

Head Office: TORONTO. District Sales Offices: MONTREAL, HALIFAX, OTTAWA, COBALT, PORCUPINE, FORT WILLIAM, WINNIPEG, REGINA, SASKATOON, CALGARY, EDMONTON, NELSON, VANCOUVER, VICTORIA, PRINCE RUPERT.

The Morrison Water Jet Pump
SAVES A MAN'S WAGES
Every Day It Operates



THE Morrison Water Jet Lifter is the latest and best all-round emergency pump for factory use. It is operated by water from the city mains, and is without moving parts or any complication to get out of order. It requires no priming—producing a vacuum of twenty-seven inches of mercury, and lifting water or other liquid successfully to any height up to thirty feet. It pumps hot or cold water; works in any position, and requires no labor or attention other than that of connecting it in place. Can be attached to either hose or standard W. I. pipe couplings.

A circular giving full particulars will be gladly mailed on request.

The James Morrison Brass Mfg. Co., Ltd.

93-97 Adelaide St. West - - Toronto, Canada

MANUFACTURERS OF A COMPLETE LINE OF POWER HOUSE ACCESSORIES AND GENERAL BRASS GOODS

CIRCULATES IN EVERY PROVINCE IN CANADA

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.
MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-153 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. VII. Publication Office, Toronto—September, 1914 No. 9

TRADE
PENBERTHY
MARK

REGRINDING CHECK VALVES

APPROVED AND REGISTERED
In Ontario and Western Provinces for Steam Pressures as high as 200 lbs.

"The All Quality Line"

SWING

VERTICAL

HORIZONTAL

ANGLE

Our COMPLETE LINE OF CHECK VALVES is specially designed, proportioned and constructed to give the best possible efficiency to the user.

THE REGRINDING FEATURE enables the engineer to keep his VALVES in the PINK of condition without extra expense or trouble.

THE PRICE OF THESE VALVES is no higher than that asked for other makes of valves which ARE NOT IN THE SAME QUALITY CLASS.

GIVE THEM A TRIAL NEXT TIME

Manufactured by

PENBERTHY INJECTOR CO., Limited, WINDSOR, ONT.

"INGLIS"
BOILERS
For Any Service

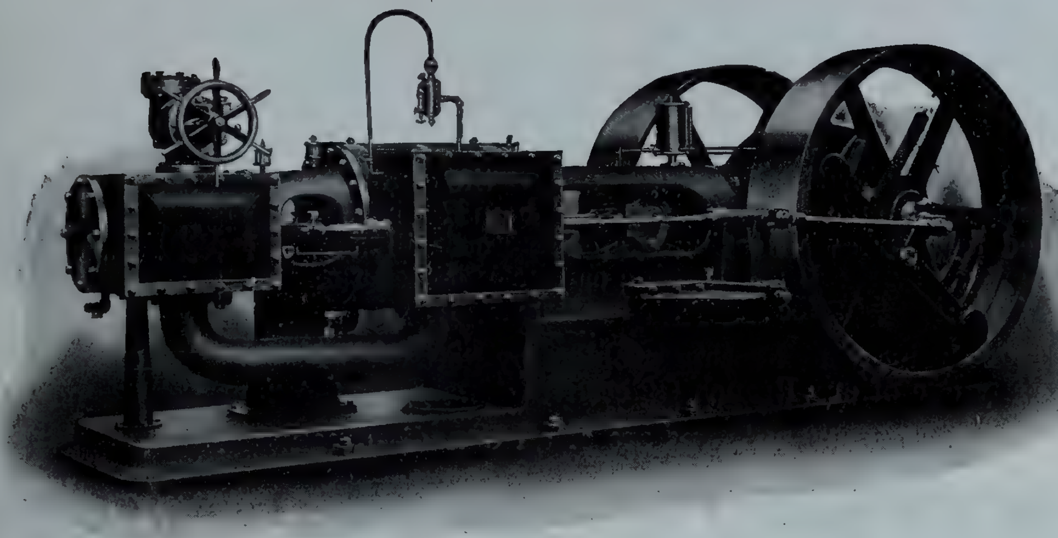
Marine Boiler built for R. & O. Nav. Co. Str. "Rapids Prince"

"Inglis" Boilers are the best. We make all kinds for any service. We are also Sole Canadian Manufacturers of the well-known Erie City Water Tube Boilers, Vertical and Horizontal.

WRITE US.

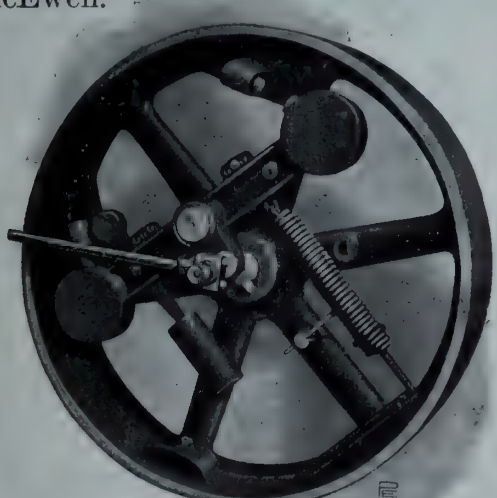
The John Inglis Company, Limited
ENGINEERS AND BOILERMAKERS
14 Strachan Ave., Toronto, Montreal Office, 509 Can. Express Bldg.

Close Regulation a Big Feature Here



THE McEWEN ENGINE

All McEwen users boast of the close regulation of their Engines. Going from full load to no load with less than 2% speed variation is easy for a McEwen.



No difficulty is experienced in adjusting McEwen Engines to govern within a limit of one revolution, and the instantaneous variation in speed when full load is thrown on or off is often less than 2%. This remarkable regulation is due to its quick-acting governor, unequaled for its refinement of construction and perfection of operation.

The Begthrup Governor is the pioneer centrifugal-inertia governor, consisting of "inertia bar" with weight at each end, a third weight cast integral with the "inertia bar," a heavy coil spring, and dash pot. The spring end of the "inertia bar" is heavier and the speed of rotation depends entirely upon the equilibrium between centrifugal force acting on the "inertia bar" and the tension of the spring, while the actual movement of the governor parts is effected by the inertia of the weighted end of the bar. The dash pot prevents racing, and it is possible to adjust the engine so that it will run faster under load than when running light, and still have it regulate perfectly without tendency to race.

No other governor will allow such a close degree of regulation and adjustment. Strong. Durable. Sensitive. Always ready.

All information gladly sent on request. A post-card will do.

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA

The Dunham Radiator Steam Trap

Insures 100 p.c. heating efficiency at the radiator with a minimum demand on the coal pile.

It gets rid of air binding and short circuiting of steam in return lines, because it is positive in action—passing all air and water of condensation but closing off tight against steam.

Freeze-up troubles are unknown where Dunham Traps are used because the radiator is always completely drained of water.

To overcome any heating difficulties during the coming season investigate the possibilities of the Dunham Radiator Trap applied to your own heating system. You will be surprised how easily the Dunham Line can be installed to give the satisfaction you need in your heating plant.

Let us help solve your heating problem by getting in touch with any one of our Branch Offices.

The Dunham Traps are of all Canadian manufacture.

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

MONTREAL—Room 20, 11 St. Sacrament St.
FORT WILLIAM—Plumbing & Engineering Supply Co.
HALIFAX—General Contractors Supply Co., Ltd., McCurdy Bldg.
VANCOUVER—520 Duncan Bldg.
CALGARY—Metals, Limited.
WINNIPEG—405 Tribune Bldg.

Made in Canada

"FROST" KING Babbitt Metal

Proves its superiority at every test

It is especially designed for saw mills, planing mills, threshing machines, traction engines, pumps, rolling mills, and pulp machinery, and all classes of **stationary** engines.

You also find our "NICKEL GENUINE" exceptionally good for babbitting dynamos and motors.

If you cannot get these babbitts from your dealer, **we shall be pleased to make you a shipment of a twenty-five pound box.**

Our Mixed Metal Sales Amount to Over $5,000,000 Annually

Hoyt Metal Co., Toronto, Ont.

New York, N.Y. London, Eng. St. Louis, Mo.

Jenckes Boilers

Horizon Tubular

Locomotive Types

ertical Tubular

Heating Boilers

are made for Low, Medium and High Pressures, of the various standard styles and to pass any inspection

Flange quality steel, conforming to Manufacturers' Standard Specifications, is used in shell and heads. The tubes are lap-welded or seamless steel of standard gauge and make; the rivets are of special quality steel, and the stays are steel, without welds.

This construction is carried on with scrupulous care at every step, which is a good reason for our claim that **Jenckes Boilers minimize stoppage for repairs.**

We have a large number of finished boilers in stock, from which we make **prompt and satisfactory shipments.** We also have a variety of sizes in process of manufacture, which can be speedily completed for delivery.

If you wish to hear what users have to say, ask us to put you in touch with some—we'll gladly do it.

Write for full particulars.

The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Toronto Cobalt
South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE., and ST. CATHARINES, ONT.

Walker's Electric Boiler Compound

Keeps Boilers FREE FROM SCALE and Fuel Bills Normal

Saves Time, Labor and Boilers

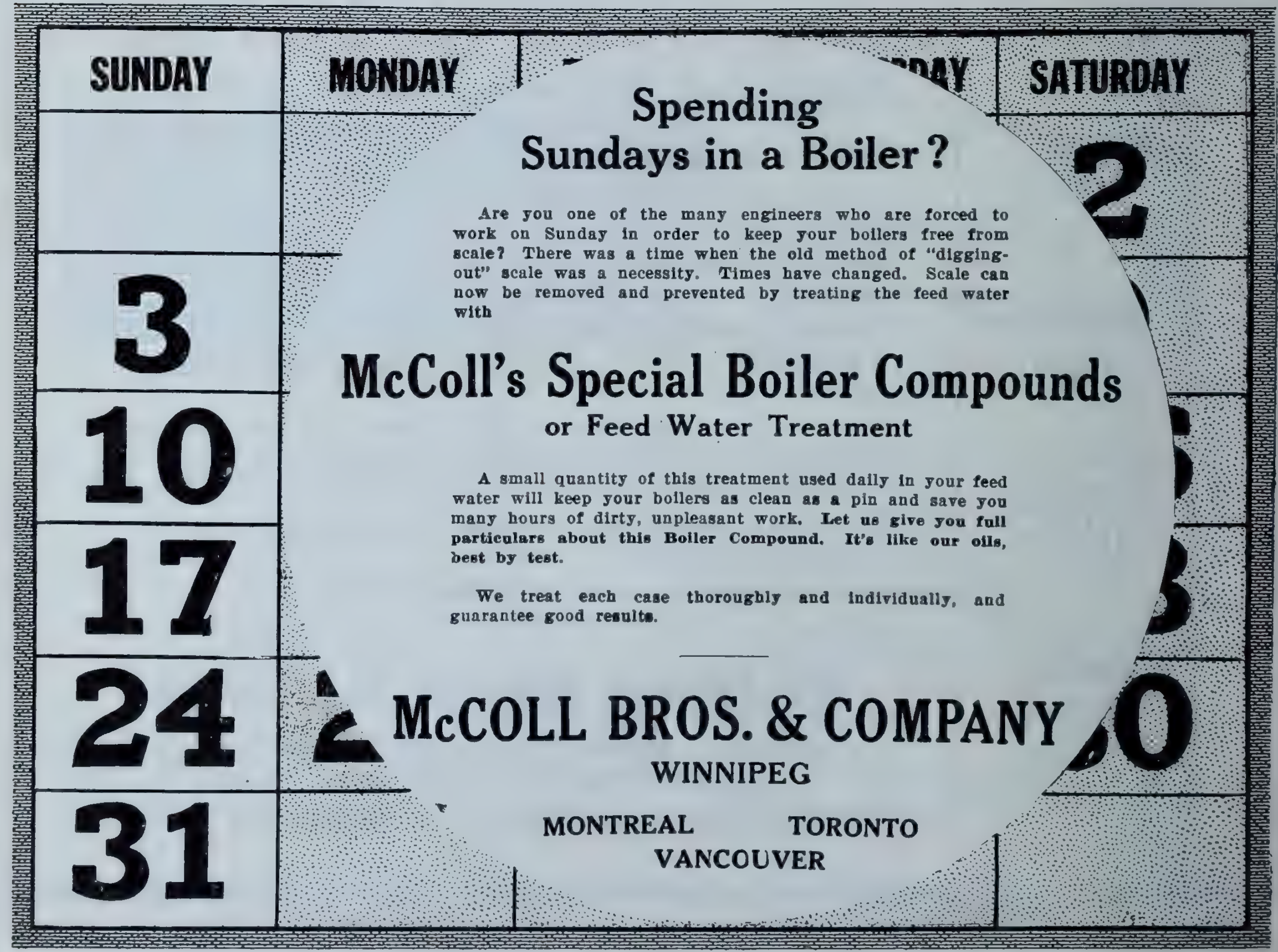
It has been demonstrated that 1-16" of scale on the tubes and shell of a boiler requires from 15 to 20% more fuel than a clean boiler.

Do you realize that this means a total waste of 1-16 of every carload of fuel?

Walker's Electric Boiler Compound will eradicate all scale, and if a **small** quantity is used daily your boilers will stay perfectly scaleless. This compound also prevents pitting, corrosion and other boiler troubles.

Guaranteed not to injure boiler fittings or pumps. Try a Barrel.

The Electric Boiler Compound Co., Ltd.
Guelph, Ontario



Spending Sundays in a Boiler?

Are you one of the many engineers who are forced to work on Sunday in order to keep your boilers free from scale? There was a time when the old method of "digging-out" scale was a necessity. Times have changed. Scale can now be removed and prevented by treating the feed water with

McColl's Special Boiler Compounds

or Feed Water Treatment

A small quantity of this treatment used daily in your feed water will keep your boilers as clean as a pin and save you many hours of dirty, unpleasant work. **Let us give you full particulars about this Boiler Compound. It's like our oils, best by test.**

We treat each case thoroughly and individually, and guarantee good results.

McCOLL BROS. & COMPANY
WINNIPEG
MONTREAL TORONTO
VANCOUVER

POTATO SCALE BOILER COMPOUND

Prevents the Fuel Waste that goes hand in hand with Scale

Why let the vital part of your plant (the boiler) waste fuel, and become low in its capacity, when you can keep it at its highest efficiency with a minimum consumption of fuel by using a few cents' worth of Potato Scale Boiler Compound daily in your feed water?

Besides keeping the tubes free from scale, it **prevents pitting, corrosion, foaming and other boiler troubles** due to impurities in the feed water.

There is nothing in this preparation that can cause the slightest injury to any kind of boiler metal.

We make it to suit feed water conditions, and guarantee satisfactory results.

Write for references and full particulars.

C. C. SNOWDON

1810-1840 11th St., Calgary, Alberta—P. O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid-Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches:— Edmonton, Winnipeg, Vancouver

Once this Gasket is put on, it stays put

That's what an old engineer told me about

J-M Kearsarge Gaskets

And my experience **proved** it is true. They do not blow out, burn out, or squeeze out. They withstand the highest steam pressures and temperatures. That's a fact.

Plates may be taken out and replaced repeatedly with the same gasket. Many a J-M Kear Gasket has given 7 or 8 years' continuous service.

These gaskets do not rot or disintegrate because they are made of practically indestructible asbestos fabric interwoven with fine brass wires.

Save Money and Time

J-M Kearsarge Gaskets, despite their superiority, cost less than ordinary gaskets because they weigh 25% less. Therefore you get more per pound. They also last much longer than ordinary gaskets. They prevent shut-downs due to blow-outs—cut out petty troubles—save the engineer's time, and help him to run his plant at the highest efficiency. The man who does this is sure of better pay.

An examination of this gasket will show you why you need it.

nearest Branch for sample and booklet to-day.

The Canadian
H. W. Johns-Manville Co., Ltd.
Toronto Montreal Winnipeg Vancouver
2390

No More Shut-Downs

due to

Leaky Pipe Joints

if you use

Genuine GOETZE No. 2 Gaskets

These Gaskets are made of copper, corrugated with asbestos lining No. 2. The corrugations allow for expansion and contraction of the pipes, while the asbestos, being forced into the pores of the metals in the flanged surface by the "squeeze" and the constant pressure of the corrugations beneath it, holds securely against the highest pressures.

Goetze No. 2 Gaskets will make the most troublesome joint you have absolutely tight — and keep it so. They "stay put" and stay tight.

Prevent leaks, blow-outs and shut-downs. Will practically eliminate renewal expense for gaskets.

Every Goetze No. 2 Gasket is guaranteed for Five Years' Continuous Service in the Same Joint. There are no "ifs and ands" about this guarantee. It means just what it says. It applies to every gasket, whether bought direct from us or through a dealer.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, Limited

St. John, N.B.

Branches at

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112 St. Peter St.

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Mills Bros.
215 Ryrie Bldg.

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C. E. Chown,
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LETHBRIDGE, ALTA.
J. B. Turney & Co.

VANCOUVER
c/o A. O. Campbell,
626 Pender St.

MANUFACTURED BY
Goetze Gasket & Packing Co., New Brunswick, N. J.

Perolin

Keeps boilers at their highest efficiency and lowers fuel costs

It's A BOILER METAL TREATMENT---NOT a boiler compound

The efficiency of feed water treatments varies because feed water conditions are continually changing.

The efficiency of PEROLIN, "The Boiler Metal Preservative," is always at its highest point, because it does not treat the water—it treats the Boiler Metal and Boiler Metals are universally the same.

Although PEROLIN is fed to the boiler in the feed water, the same as water treatments, it does not affect the water.

The contraction and expansion causes scale to crack. PEROLIN works through these cracks to the metal—and works along the metal, loosening the scale mechanically, so that it can be readily washed out.

When old scale is thus removed, PEROLIN forms a preservative film over tubes and shell. This film prevents scale-forming substances from adhering to the metal and prevents pitting, corrosion and galvanic action.

The preservative film is an efficient transmitter of heat; it keeps the boiler up to its full rated capacity, and as a result, it effects an enormous saving in fuel, boiler repairs and unnecessary work for the engineer.

The results produced by PEROLIN effect a saving which will pay for all the PEROLIN used many times over.

Universally used throughout Europe for the past eighteen years. During the last four years, over thirty thousand plants in Canada, United States and Mexico have been secured. It's giving satisfaction everywhere.

We'll ship you, freight prepaid, a sufficient quantity to test for sixty days.

REMEMBER—If not satisfied with the results—return what you have left, and the amount used will cost you nothing.

Perolin Company of Canada, Limited

76 Adelaide St. West **Toronto, Ont.**

Quebec Agents: Burroughs, Joyce & Co., 30 St. John St., Montreal, Que.

Manitoba and Northern Ontario Agents: Engineering & General Supply Co., Ltd., 206 Nanton Bldg., Winnipeg, Man.

Alberta Agents: The Western Supply & Equipment Co., Ltd., Calgary, Edmonton and Lethbridge, Alta.

British Columbia and Yukon Agents: Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

GUARANTEE

We guarantee PEROLIN, the Boiler Metal Treatment.

1. To loosen scale already formed in the boilers by its mechanical action;

2. To Prevent New scale from forming;

3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;

4. To correct troubles caused by oil and grease getting into the boiler water;

5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;

6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;

7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;

8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

Do You Have Trouble with Your Rod Packing Under High-Pressure Superheated Steam?

If it's not made of the right material the extremely high temperature will either char or harden it in a very short time.

If your conditions are up-to-date and difficult you need

"PALMETTO"
REG TRADE MARK
• PACKING •
Reg. U. S. Pat. Office

because heat does not affect it and its own lubricant keeps it soft and pliable.

LONG SERVICE UNDER HARD CONDITIONS CAN BE RELIED UPON from "PALMETTO" Packing.

Let us send you a free working sample and prove that "Palmetto" is just the packing you need. No salesmen will trouble you.

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 DUANE STREET NEW YORK

Canadian Distributing Agents, The Canadian Fairbanks-Morse Co., Ltd., Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

Heroes of the Engine Room

When on the night of June 25, fire destroyed a third of the city of Salem, Mass., five men in the generating station of the Salem Electric Lighting Co. stuck to their posts while flames roared outside the building and beat against the walls, roof and wire-glass windows of the plant. These men had every chance to escape before the fire reached the station, but the motto of the steam engineering profession—"DUTY FIRST"—kept them steadfast, and in the face of death they won out by keeping the lights of Salem lighted when darkness would have meant added terror to women and children huddled in endangered homes or fleeing through the streets. We salute these heroes of peace.

DANIEL'S ROD PACKING

P. P. P.

FOR STEAM, AMMONIA, AIR, WATER.

The best that **solid** packings can do is to hold steamtight, but this is done by maintaining an **unvarying** and **maximum** pressure on the rods during the **entire** travel of the piston.

P. P. P. holds steamtight and also varies the bearing on the rods with the increase and decrease of the pressure within the cylinder. When the steam is acting from the **head** end, there is practically no pressure on the rod except during the period of compression; when the steam is acting on the **crank** end, the bearing of P. P. P. on the rods decreases with decreasing pressure of the expanding steam.

This means a saving of from 75 to 90 per cent. of the FRICTION on rods. Scientific tests show savings of $100.00 to $500.00 of power cost, per rod, yearly.

Give P. P. P. a trial; it's worth it.

License Examination Book, FREE

Fill out and mail the coupon to us. We will send you a FREE copy of our Blue Book of Questions and Answers to Engineers' License Examinations.

Your name ....
Address ....
Employed by ....
Address ....
Horsepower of engine ....
Kind of Rod Packing used ....
Kind of Sheet Packing used ....
Dealer's Name ....
Address ....
Name of Buyer ....
.... Series 24-I

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.

GARLOCK

"Holdtite" Style No. 899

The Packing made specially for Extreme Pressures and Temperatures.

"Holdtite" will hold superheated and high-pressure steam, hot gases, ammonia, acids, alkalies, hot oils and other fluids and gases that are death and destruction to other packings.

Will successfully stand a temperature of 1500 degrees Fahr., and has a tensile strength of 6,000 lbs. per square inch. **Does not harden in joints.**

We offer every engineer an opportunity to test our style No. 899, so as to determine for himself whether or not our claims for the durability and efficiency of this packing are justified.

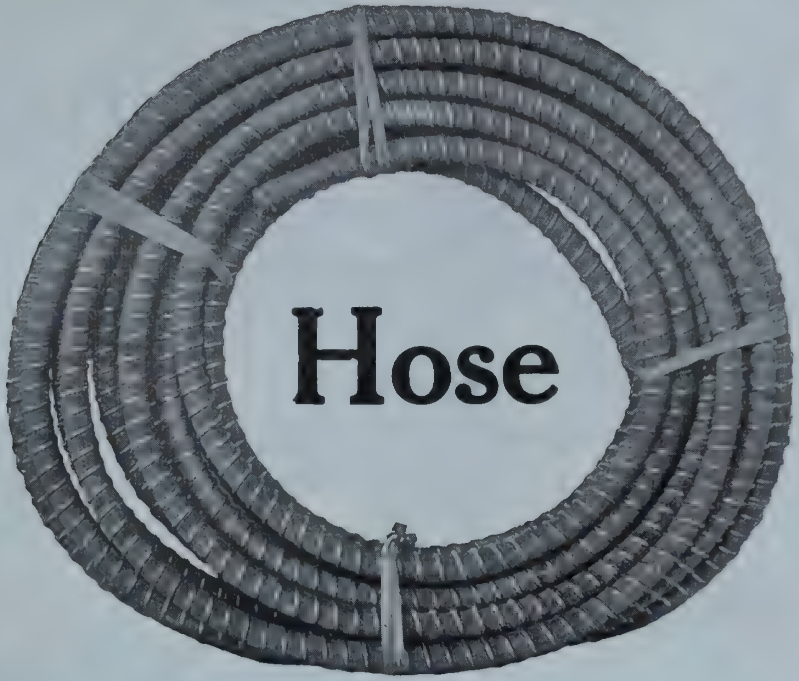
SEND FOR A SAMPLE TO-DAY AND LITERATURE

The GARLOCK PACKING COMPANY

Hamilton, Ont.

Montreal **Toronto** **Winnipeg** **Calgary**

"Pioneers in the Packing Business and Specialists"



Made for Service

Hose bought on *price* is always the costliest hose. When such Hose gives out it not only means the price of a new hose, but often the added and still more serious expense of a costly breakdown.

When you buy Hose, buy the Goodyear way. Put your Hose problems up to Goodyear efficiency experts. Let them tell you why the particular Goodyear Hose they recommend is exactly the Hose you need for the particular purpose. Buying Hose knowingly beforehand is real insurance. Hose made and bought on a service basis is always cheaper in the end than Hose made to meet a price.

"BlackDiamond" Brand

Has a Marline woven jacket and different tube compounds for air and steam. The Marline cover allows for even expansion and comfortable handling. This is a Hose made for honest service—a Hose that spells economy by reason of its wonderful durability.

"Goodyear" Brand

Similar to Black Diamond, but made with a special steam, heat and oil resisting tube—a tube specially compounded so that it won't cook itself to death like ordinary hose. Rapid hardening of the tube cannot occur.

Also comes wire wound. This means added durability where hose is roughly handled and used. The wire winding protects the outer cover. Keeps the hose intact under most grueling conditions.

GOODYEAR
TORONTO

Mats for the Dynamo Floor

Goodyear mats for the floor and front of the dynamo are so carefully compounded that they are absolute insulators. That's a mighty important consideration when buying switchboard and dynamo mats.

Use Goodyear Efficiency Service

Whenever you need Hose, Belting or Packing consult Goodyear efficiency experts. Remember that Goodyear leads in the Mechanical Goods field as in automobile tires. Asking questions costs you nothing. No obligation is involved. This forethought will save you money, time and trouble.

The Goodyear Tire & Rubber Co. of Canada, Limited

Head Office, Toronto, Ont. **Factory, Bowmanville, Ont.**

Branches at VANCOUVER, EDMONTON, CALGARY, REGINA, WINNIPEG, HAMILTON, OTTAWA, MONTREAL, ST. JOHN, N. B.

Service Considered—

D. K. McLaren's
Leather Belting

It doesn't require the attention and expense that is common where ordinary belting is used, and its grip means efficient delivery of power.

It is the result of selection of hides by experts, and our **Genuine British Oak method of tanning**—a slow process which makes leather exceedingly tough, durable and flexible.

Many of the **Largest Canadian Plants are our steady customers.** If you wish to ask them how they like this belting, we will be glad to send you their names and addresses.

Our (Oak leaf trade-mark) guarantee is on every piece of D. K. McLaren's Leather Belting. Look for it.

D·K·McLAREN
LIMITED

MONTREAL	ST. JOHN, N.B.	TORONTO	VANCOUVER
351 St. James St.	64 Prince William St.	200 King St. W.	847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. East, WINNIPEG, MAN.

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.

We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

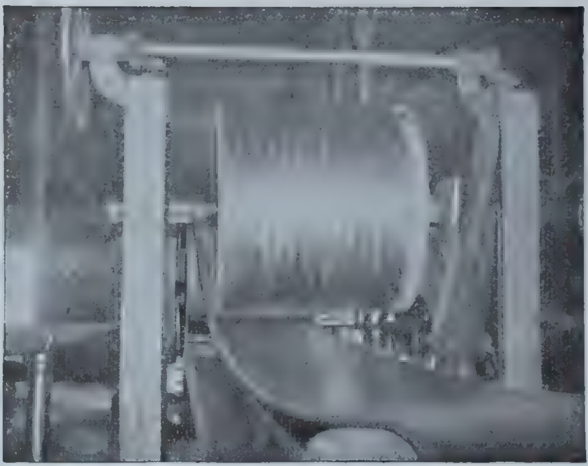
CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.

Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me **free of charge** a half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....



Would it not be better to buy a package of Cling-Surface than expensive apparatus like this?

This 1000-pound Tightener lost its job after the Belt was treated with Cling-Surface.

Many users of belts have the mistaken idea that tighteners are always necessary on short drives where one pulley is small and the other large.

This photograph shows a 1,000 lb. tightener in the New York Aqueduct Construction Plant near Yonkers, N.Y., that was so used on an old and oily 30 in. leather air compressor belt. But, **the tightener did not prevent slip.**

It is very difficult to make hard belts pull heavy loads without slip. The too frequent proceeding, as in the above case, is to increase belt tensions in one way or other. The high tension method is **wrong.** This the Yonkers people learned after starting Cling-Surface treatment over a year ago. The tightener rapidly became superfluous, for the belt stopped slipping and **it now runs with a sag of 13 inches.**

The belt is made pliable, clinging, efficient, slipless, not sticky. We can refer you to hundreds of dusty factories, mills, potteries, brick plants, woodworking plants, etc.—where belts properly treated with Cling-Surface **do not gather dust.**

Invariably belts treated in accordance with our directions can be run slack or easy without excessive tension, just as in the example cited above.

Write us details about your belts and your troubles, and we will tell you just how to proceed to effect maximum economy. Or, at least, write at once for further information if you care for better belt service. We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo N Y

I am interested in Cling-Surface and your trial order proposition.

Name .... **Position** ....
Firm ....
Street ....
City .... **State** ....

71

DURABLA

Superheat
—
Wet Steam

High Pressure and Oil

SOLD IN SHEETS AND GASKETS

Is Sold on a Service Basis

Increases efficiency, and lowers the cost by the year.

NEVER PULPS. NEVER BLOWS OUT.

Manufactured by
DURABLA MANUFACTURING CO., NEW YORK
Canadian Sales Agents
CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, Calgary, St. John, Toronto
Saskatoon, Quebec, Winnipeg, Vancouver.

Don't Gamble With Lubricators

Poor lubrication means increased friction and increased friction means loss of power, bigger fuel bills and more wear and tear on the engine.

Poor lubrication may result in an injured engine, expensive repairs or a complete shut-down at a most inconvenient time.

It doesn't pay to take chances with your lubrication because there is too much at stake.

Detroit Lubricators are designed to eliminate every element of chance or uncertainty from the lubrication of any kind of machine.

Over half the lubricators in the world are Detroits and wherever a Detroit Lubricator has been used the name Detroit has come to stand for sureness and certainty.

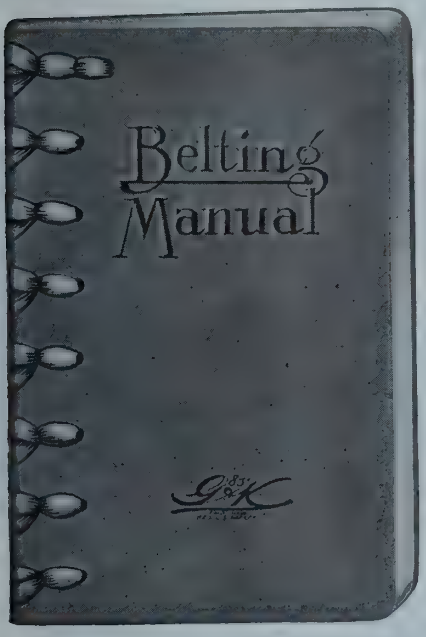
CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

1851 G&K
TRADE MARK

Educational Talks on Leather Belting.

The "Care of Belting" Manual—Yours

To obtain the highest efficiency in power transmission, is the problem which confronts every manufacturer. For years leather belting has demonstrated its ability to stand more abuse and come out "alive" than any other means of power transmission. It is an undisputed fact that if leather belting is given a tithe of the attention which of necessity must be given to other forms of transmission, it will demonstrate beyond question its greater efficiency and economy.



Actual Size 3¾" x 5¾"—90 Pages.

To promote this efficiency and economy is the fundamental object of

The "Belting Manual"

with its 90 pages of practical belting information.

It tells how to install belting, how to care for belting, how to repair laps, how to make belts endless, how to apply dressings, how to lace belts, how to clean belts, how to remedy some of the belt troubles, how to find width and length of belts.

The various mechanical rules are unusually complete, and compiled for use in solving the daily problems of power plant practice. In short, the "Belting Manual" is an authentic text-book on the transmission of power—it is a veritable fund of information for every belting user.

A copy will be sent you gratis upon request—Clip the coupon.

Clip the Coupon—to-day

The Graton & Knight Mfg. Co.,
Unity Bldg., 46 St. Alexander St., Montreal, Que.
Gentlemen:
Send, at once, the "Belting Manual."
Name ....
Address ....
Position ....
Company ....
P.H. 9-14

THE GRATON & KNIGHT MANUFACTURING CO.

Oak Leather Tanners and Belt Makers

Unity Building, 46 St. Alexander St., Montreal, Que.

Home Office and Factory: Worcester, Mass., U.S.A.

"American" Steel Split Pulleys

For Double Belts

THE PROVEN OUT KIND

Perfected by Twenty Years' Experience Superior in Efficiency at All Points

Proof of important economy in using "Americans" submitted on application.

Sizes 3″ to 66″ inclusive—Larger diameters on application.

All "Americans" above 6″ diameter have grooved faces—air escape.

Crown and Straight faces.

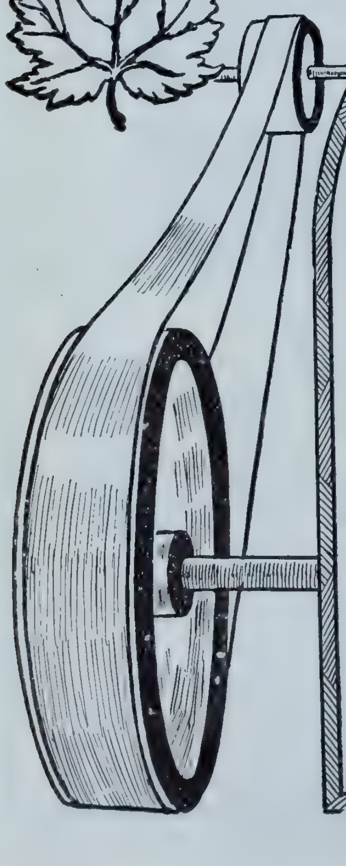
Stocked and sold by dealers

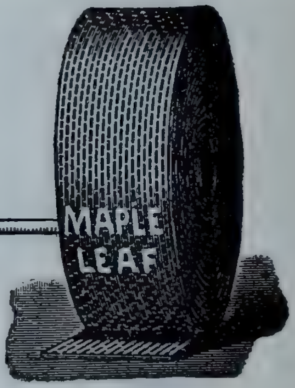
Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS:—Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N.B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.

The American Pulley Company

Philadelphia **New York** **Boston** **Chicago**

"MAPLE LEAF"





Stitched Cotton Duck Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

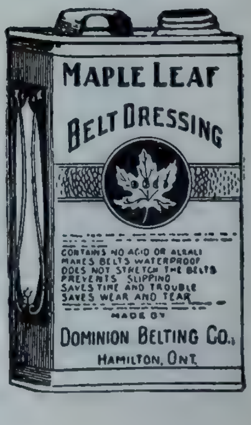
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing

The BEST for all kinds of belts

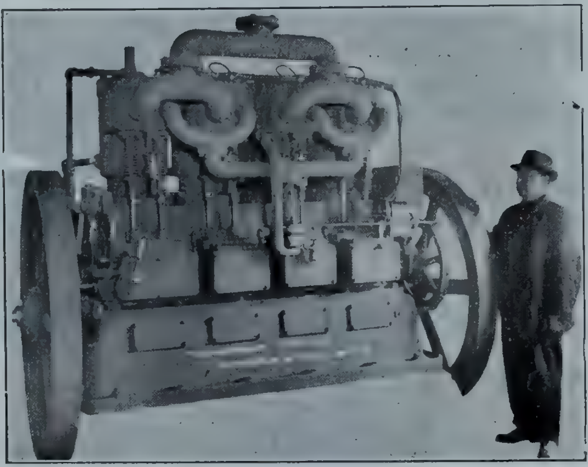
Dominion Belting Co., Limited
Hamilton, Canada



MAGNOLIA

GETS AWAY WITH

THE HARD PROPOSITIONS AND "NEVER GIVES A MOMENT'S ANXIETY"



Enterprise Machine Company

Manufacturers of

Westman Gasoline Engines

Minneapolis, Minn., Feb. 3rd, 1914.

Gentlemen:—

Replying to your recent favor, will say that we have used Magnolia Metal for several years on our high-speed Marine Motors, and on medium and slow-speed engines for heavy duty, such as dredging, hoisting, ditching and tractor purposes, and have always found it very satisfactory.

We are sending you a photograph of one of our engines, which has run for two years on Magnolia. It develops over 100 H.P., weighs, complete, 15,427 lbs., and runs at 250 r.p.m.

This Westman, on a dry land ditching machine, handled over 250,000 yards of material in Alberta last summer, hoisting the 2½-yd. bucket three to four times per minute all day. The bearings never gave a moment's anxiety.

Very truly yours,

ENTERPRISE MACHINE COMPANY,

A. F. Daggett, Secy.

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

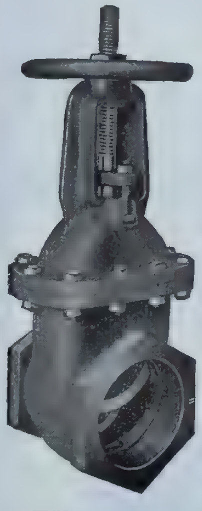
225 St. Ambroise St. **MONTREAL**

ARE YOU SEEKING SOME MEANS OF IMPROVING THE EFFICIENCY OF YOUR PLANT?

JENKINS BROS.' TYPE "K" IRON BODY GATE VALVES

will satisfy your wants because they give the best of service under exacting conditions. Users are unanimous in their testimony to-day—based upon the knowledge of and experience with inferior valves—that there are NONE to EQUAL the Genuine JENKINS BROS.' VALVES.

The Diamond trade-mark is cast on the body of all Genuine valves for your protection



TYPE "K"
Iron Body, O S & Y Gate Valve Screwed
Fig. 403

JENKINS BROS.' TYPE "K" GATE VALVES

DESCRIPTION

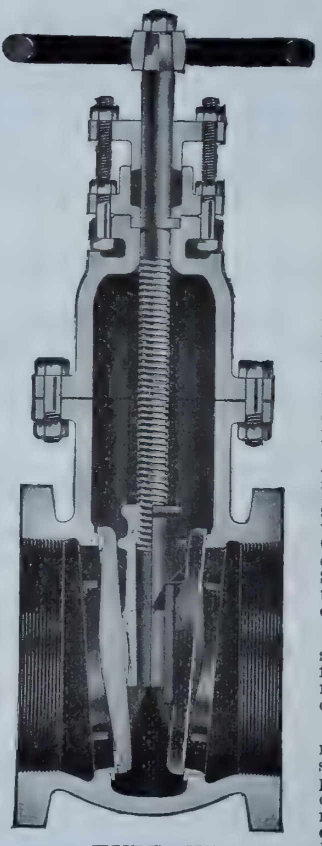
These Valves have been very carefully designed; the metal is evenly distributed and they possess great strength.

The design is such that there is an entire elimination of straight lines and sharp corners which develop weakness and are a constant source of danger.

The elliptical design, the ample thickness and even distribution of the metal and short body, have produced a Valve of great rigidity and strength and handsome appearance.

It will be noted that the Valves are fitted with taper seats. By means of special machines and tools of our own design, the Valve Body is bored, faced and threaded and the Seat-Rings screwed in and faced off, without removing the Valve Body from the Chuck, thereby accurately maintaining the angles of the Seats.

The Ball and Socket Bearing between the Discs and the Spindle-Nut insures uniform distribution of the strain, due to the closing action, making the Discs self-adjusting, so that they will accommodate themselves to any scale or sediment which may lodge on one of the Seats.



TYPE "K"
Iron Body, Inside Screw Gate Valve, Screwed (Sectional)
Fig. 401

JENKINS BROS.' TYPE "K" GATE VALVES

SPECIFICATION

Body and Bonnet made of the best grades of Scotch and other irons, producing sound castings of great strength. The whole valve is compact and strong. The passage through the valve is guaranteed equal to the full opening of the pipe.

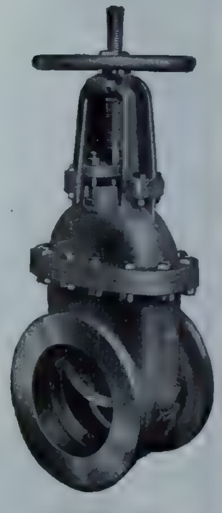
Spindle—The highest grade bronze, accurately machined, of ample strength and with powerful thread.

Seat-Rings — Bronze, very heavy, and fitted with lugs, by which the Seat-Rings are screwed into the body and by which they may be removed. Careful note should be made of this important feature. Seat-Rings are screwed down to a shoulder and then accurately faced.

Discs — Iron, faced with special bronze disc-ring forced into a double-grooved recess in the disc and then carefully faced off in a lathe.

Stuffing box of ample dimensions and packed with special moulded asbestos rings possessing such a high degree of durability that they will not require renewal for several years. Stuffing-box can be re-packed while valve is under pressure and wide open or closed.

Pipe Threads tapped on special machines, insuring accuracy and perfect alignment.



TYPE "K"
Iron Body, O S & Y Gate Valve anged
Fig. 404

Stocked by all first-class dealers.

CATALOGUE SENT FREE UPON REQUEST.

JENKINS BROS., Limited

103 St. Remi Street **MONTREAL**

"Dart" Union

PIPE COUPLINGS

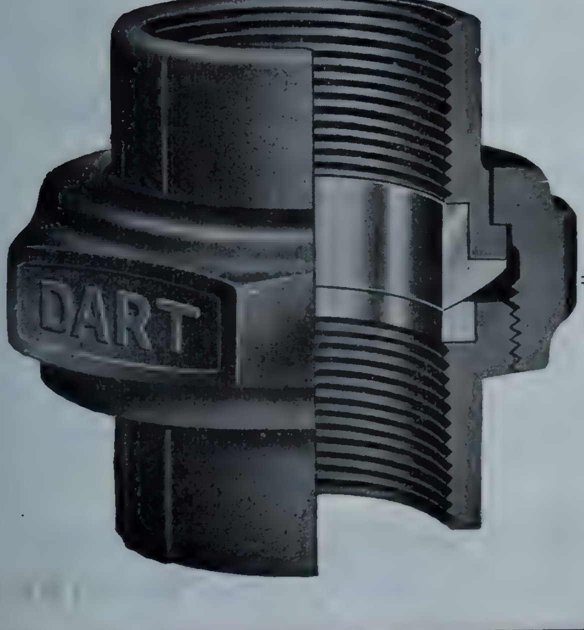
BRONZE TO BRONZE at the joint — *No Corrosion*

The Ball Shaped seat allows a quickly and easily made connection, whether pipes are in or out of line—a connection that STAYS tight until deliberately loosened with a wrench.

The Dart is proof against expansion, contraction, and vibration, because of its heavy iron parts.

Dart Unions are the only product of our factory, so that our whole attention and force is concentrated, which insures a maximum of care, of attention to details.

No upkeep cost. No replacement cost, and no loss from leaks.



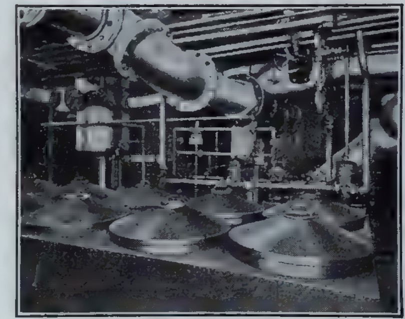
Every Dart bears our trade-mark (your guarantee). Any defective dart will be replaced 2 for 1.

Sold by Jobbers Throughout Canada

Manufactured by

Dart Union Co., Ltd., Toronto

How Big Concerns Make Oil Pay



Bowser Oil Filtering and Circulating System installed for the Curtis Publishing Company, Philadelphia. 2F Type with ten large filter sections. Connected to one simple and six cross-compound engines, two ammonia compressors, pumps and other machinery.

Big concerns like the Curtis Publishing Company and National Cash Register Company, have had the oil filtering and distribution problem solved.

They have found the way to get the oil to every point of contact—to make every drop do full service—to use it over and over again—to keep bearings and other parts "sweet" and clean—the equipment at the highest point of efficiency *all* the time.

They have installed

BOWSER
ESTABLISHED 1885

Oil Filtering and Circulating Systems

A Bowser system stores and distributes the oil. Reclaims it. Saves time and money in the doing of it. There are big systems for large concerns—smaller ones for others. A Bowser system for every kind of equipment—for *your* kind. All told there are over 500 different Bowser systems. A million users. For thirty years the Bowser Company has specialized in but this one thing—*the solving of oil storage and distributing problems.*

Ask Questions

Put your problems up to Bowser. Thirty years of such experience may mean something to you. There's a book which you can also have. It's free. Get in line to put *your* oil equipment on a real efficiency basis.

The Bowser Oiling System used in connection with Power Department of the National Cash Register Co. Supplies stream oil feed for two 1200 h. p. cross-compound, one 600 h. p. tandem compound, and one 300 h. p. tandem compound engines—one 3,000 cu. ft. and one 2,000 cu. ft. air compressors.

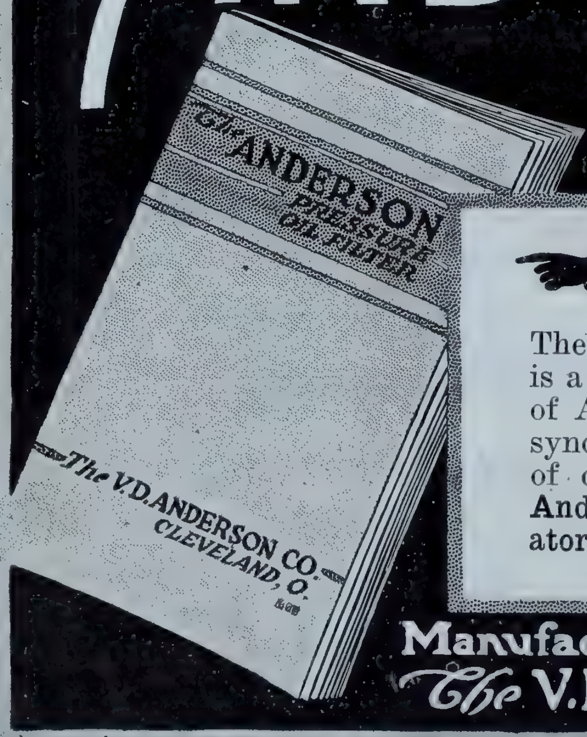
S. F. Bowser & Co., Inc.

Engineers, Manufacturers and Original Patentees of Oil Handling Devices

330 Frazer Avenue
Toronto, Ontario, Canada

Sales Offices in all Centers and Representatives Everywhere

The ANDERSON
PRESSURE OIL FILTER

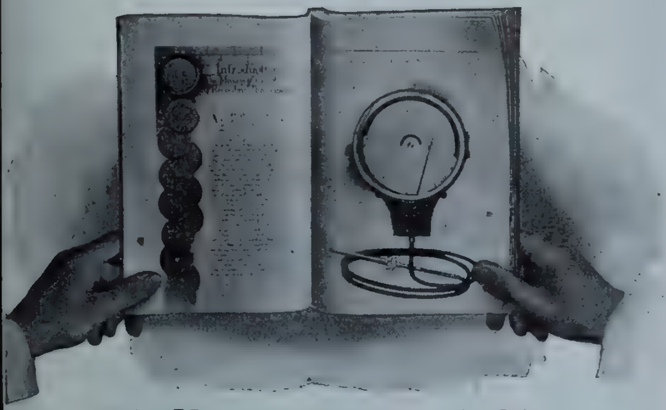


☛ WRITE FOR IT

The Anderson Pressure Oil Filter Catalogue is a brightly illustrated and lucid description of Anderson Oil Filters. It is an educative synopsis of the uses, capacity and structure of our product. Mention is also made of **Anderson Steam Traps, Air Traps, Separators, Water Columns, etc.**

Manufactured by
The V.D.ANDERSON CO. Cleve'd,O.

We Want You to Have a Copy of Our New Catalog



It's Yours for the Asking

Don't you hesitate one minute, Mr. Engineer, in sending for a copy of this unusual catalog devoted to the "Columbia" Recording Thermometer — 42 pages "chuck full" of interesting and comprehensive data —telling of the mission of the Recording Thermometer —its great value in helping you to obtain a maximum amount of power from a minimum coal consumption by enabling you to keep strict tabs on boiler feed water temperatures, flue gas temperatures, etc.

The Catalog is profusely illustrated, showing the numerous types of

Columbia Recording Thermometers

—telling of the many new features which are absolute departures in Recording Thermometer construction. Telling why the "Columbia" has been recognized, by its undisputed superiority over contemporaries, of principle, design and construction, to be the LOGICAL Recording Thermometer for unfailing accuracy and dependable service in power plants and all industrial fields.

If you want to be "up to the minute" in Recording Thermometer construction, send a postal to-day for a copy of this valuable catalog. Just say: "Send me Catalog W 300."

The Schaeffer & Budenberg Mfg. Co.

Makers of the "Columbia" Recording Gauge and other Power Plant Instruments.

Brooklyn, N.Y.

For any range of temperature up to 1000° F.

PIPE THREADING

Threads from 1-in. to 2-in.

"Matchless"

It sometimes seems impossible to thread pipe tucked away in a corner against the wall or cramped in a narrow ditch. In difficult work of this type a man needs not only a tool designed for close work, but a tool that is operated with almost no effort. In other words, a man needs

OSTER Pipe-Threading Tools

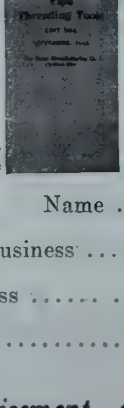
The Matchless Ratchet Stock (above) is a very strong, very easy-cutting tool used either with one handle as a ratchet tool or with two handles as a regular die-stock. It swings in 14-in. circle—threads pipe 5 in. from wall. The threading dies are very narrow and are receding, allowing only a few teeth to cut at one time. This greatly reduces the labor. The leader screw is guarded by our chip shield (exclusive pat.) and **never** needs replacing. Other patented and valuable features distinguish the OSTER MATCHLESS above all other pipe-threading tools.

The Oster Mfg. Co.

2099 E. 61st St. **Cleveland, Ohio**

Write to-day for complete catalog.

In 24 Canadian cities are supply houses carrying Oster tools.



Kindly send me by return mail complete catalog and folder on Matchless Ratchet Tools.

Name ....

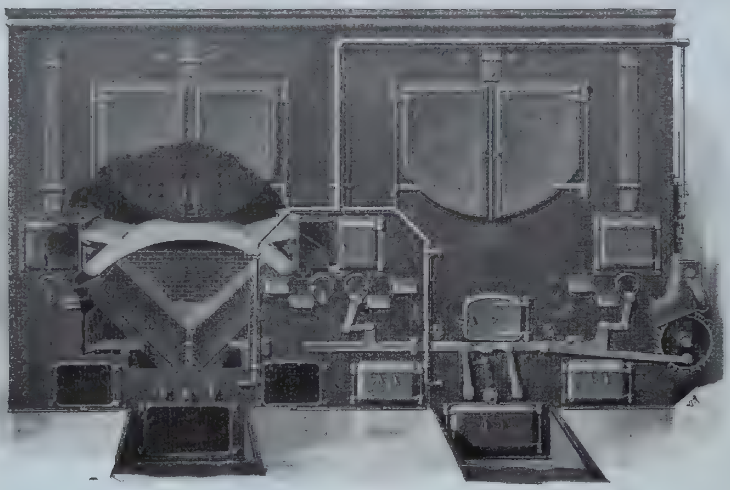
Business ....

Address ....

City .... State ....

(2099)

Murphy Automatic Smokeless Furnaces



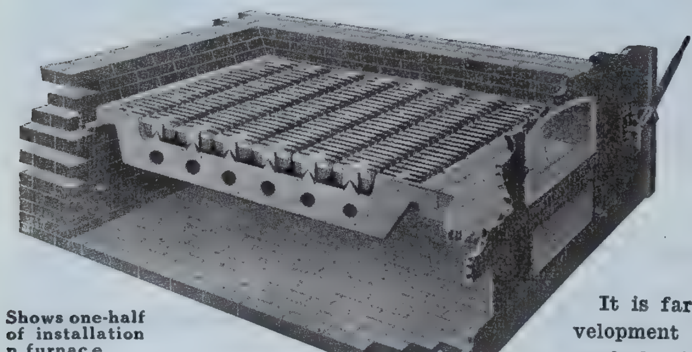
The first installation of Murphy Furnaces made for the Provincial Government was for 5 furnaces, in 1913, at the "ONTARIO INSTITUTE FOR THE DEAF AND DUMB," at Belleville. The results so satisfactory as, that in July we obtained contract for 4 300-H.P. units, to be installed in the new power plant at "THE HOSPITAL FOR THE INSANE," at Whitby, Ont.

NO OWNER of a steam power plant CAN AFFORD to burn coal under hand-fired conditions!

For list of users and catalogue, address

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

The McNaughton Grate



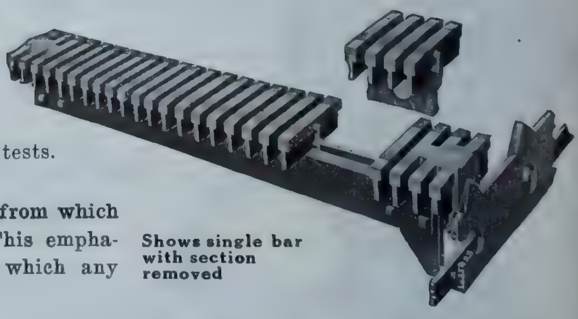
Shows one-half of installation n furnace

has a PLAN OF DRAFT SURFACE which instantly commends itself to the practical engineer.

The Draft Openings extend across the face of the whole Grate, which means that you have the maximum air space after providing the requisite structural features necessary to support the fuel without wastage.

It is far past the development stage. The method of construction has been established from the result of practical and convincing tests. It does not dump.

NOTE the Rocker Grate from which a section is removed. This emphasizes the economy with which any portion can be removed.



Shows single bar with section removed

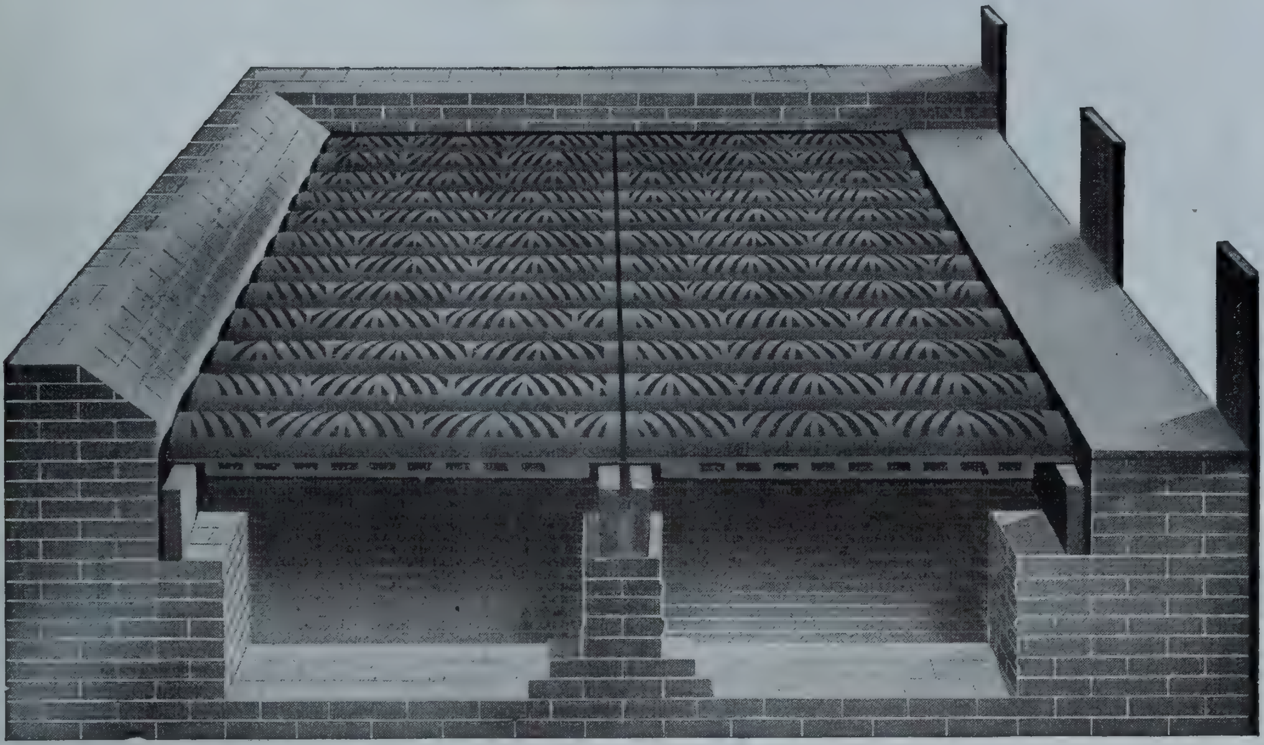
Will exhibit at the Canadian National Exhibition.
Mr. F. W. Donaldson, of 422 Euclid Avenue, Toronto, will be in charge of exhibits.
Be sure to pay him a visit.

Galt Foundry Company Galt, Ontario

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR—COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

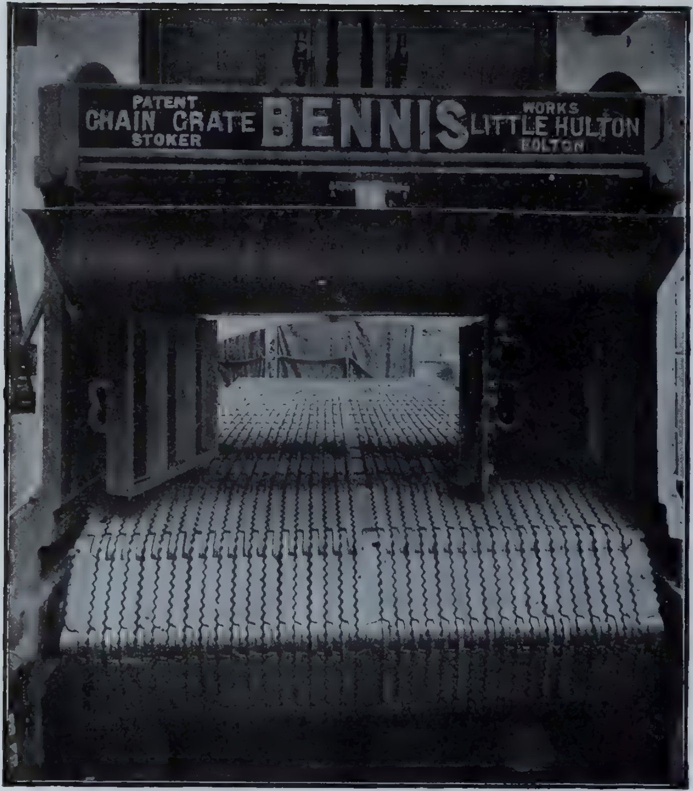
FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.



BENNIS

LONG-LIFE-LINK

CHAIN RATE STOKER

More air space is provided to each square foot of grate area than with other makes, and without additional widening of the *actual* air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

Fine slack fuels can be satisfactorily burnt.

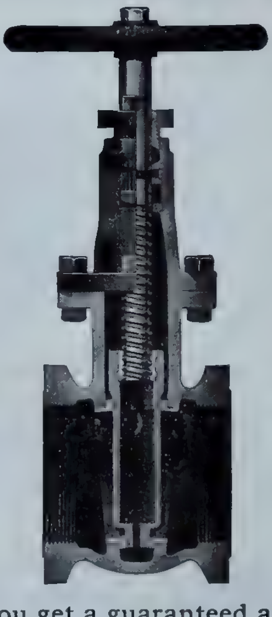
Write for "Boiler House Economy" Pamphlets, and Full Particulars to

GEO. H. TOD, 213 Manning Chambers, Queen St. West, **TORONTO**
WINNIPEG, 601 UNION BANK BUILDING

KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

LUNKENHEIMER

WHISTLES

Plain, Single Bell Chime, Variable Sound, Electrically Operated, Three-Whistle Chime, etc., made in all standard sizes.

The large and complete line of Lunkenheimer Products also includes **Bronze** and **Iron Body Bronze Mounted** Globe, Angle, Cross, Check, Throttle, Gate, Non-return Boiler Stop, Lever, Pop Safety, Relief, Blow-off, Screw-down Check Valves, etc.; *"Puddled" Semi-steel* and *Cast Steel* Valves of all types; Water Columns, Gauges and other Boiler Mountings; Ground Key Work of all descriptions; Injectors and Ejectors; Lubricators and Lubricating Devices; Oil Pumps, Oil and Grease Cups; Gasoline Engine Specialties, etc.

Your local dealer can furnish them; if not, write us.

A complete description of the entire line can be had by referring to Lunkenheimer No. 50 Catalogue. Write for a copy.

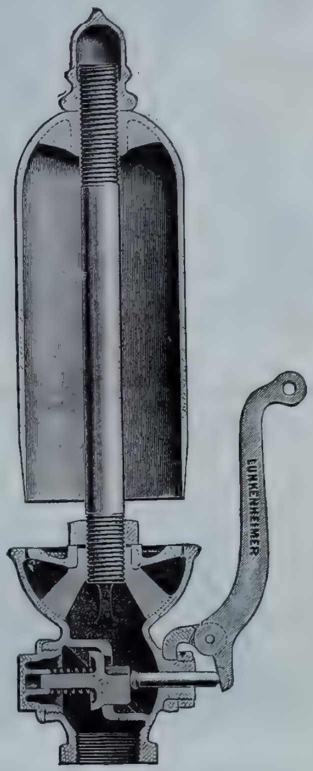
THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI, OHIO

NEW YORK CHICAGO BOSTON LONDON



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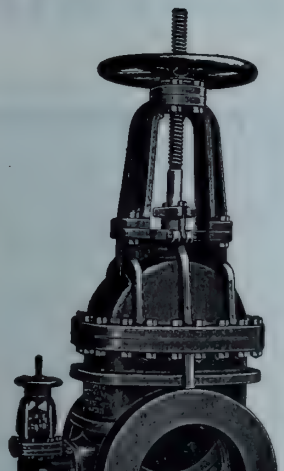


Pratt & Cady Valves

with Renewable Bronze Seat Rings

Those who are looking for a valve of the highest grade, one which they can rely upon to help in their "Safety First" campaign, will do well to choose the P. & C. line of gate valves, made in Brass and Iron from 1¼" up; they all have the same

Retaining Ring Construction

The seat rings are independent rings of bronze, or any special metal or material best adapted for the service in which the valve is to be used. These seats can be renewed by removing the retaining rings with a suitable wrench made for the purpose, or other appropriate tool. The gate is a double-faced, wedge-shaped casting, with side grooves by means of which it slides on guides in the valve body.

Great pains are taken in the machining of all parts of these gate valves. Gauges are used on each part to insure their accuracy and interchangeability. The guides in the bodies are of equal thickness, and the wedges can be taken out of the valve and replaced with the opposite faces in contact, and will give an accurate fit. The importance of this in making repairs is obvious. These valves being double-seated can be used with the pressure applied at either end.

For Superheat and High Pressure, Wet Steam and Oil, use Durabla Packing.

The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Quebec Ottawa Toronto Hamilton Ft. William
Winnipeg Regina Saskatoon Calgary Edmonton Vancouver Victoria

Canada's Departmental House for Mechanical Goods

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

Bulletins sent on request.

The Vilter Mfg. Co.
242 Becher St. Milwaukee, Wis.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration.

De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

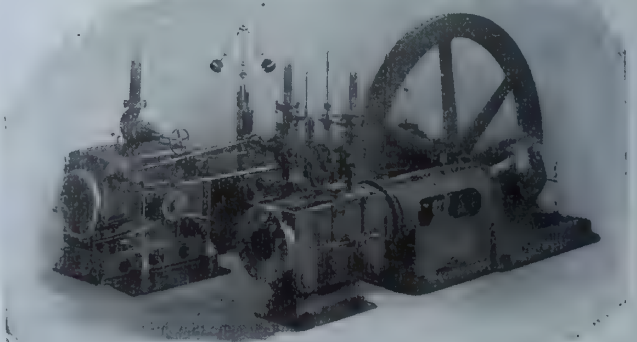
The name **De La Vergne** stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada



The Largest Ice Dealer in Detroit Installed Two H. & C. Safetys a Year Ago.

Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

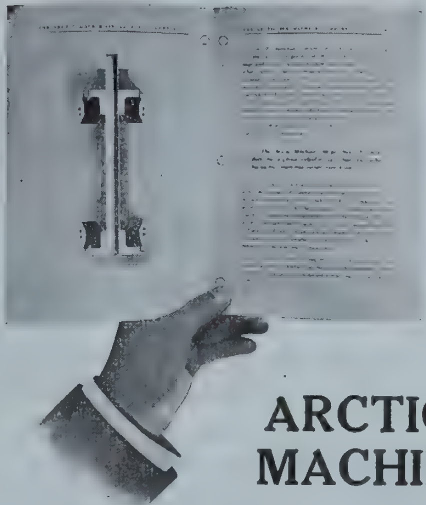
During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of **6 3-10 K.W. per ton or more than 11½% saving in power consumption.**

You, Mr. Iceman, should check up on your costs and capacity against these records.

Write us to-day for a Pittmans & Dean chart of their year's results.

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Refrigerating and Ice-Making Machinery
DETROIT 42nd Year. MICHIGAN



Worth Your Study

ARCTIC ICE MACHINERY

The Ammonia Compressor guaranteed to produce 20% over-capacity as compared with any other Horizontal ice machine of equal size on earth—it's a mighty interesting proposition. Bulletin 1-P explains the construction.

ARCTIC-POWNALL RAW WATER ICE PLANTS

Are causing orders and inquiries from all parts of the world—and the sparkling purity and freedom from taste or odor of this ice deserve the popularity it has achieved. Ask for full particulars.

"WE DO IT RIGHT."

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

J. V. Jamison, Pres. **T. B. South, Vice-Pres.** **J. V. Jamison, Jr., Sec. & Treas.** **R. L. Jamison, Order & Ship. Dep't.**

Cold Storage and Freezer Doors either Standard or Fireproof **DOORS**

The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones'." Built for strength and durability.

We have a 68-page profusely illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

- **The "Jones" Cold Storage Window.**
- **The "Jones" Automatic Ice Recording Doors and Chutes.**
- **The "Jones" Platform Ice Passing Chute and Door combined.**
- **The "Noequal" All Steel Automatic Ice Chute.**
- **The "Noequal" Revolving Ice Cream Passing Door (Wood or Steel)**
- **The "Jones" Vertical Sliding Door.**

JAMISON COLD STORAGE DOOR CO.
FORMERLY
JONES COLD STORE DOOR CO.
HAGERSTOWN - MARYLAND, U.S.A.

"Jones" Standard Automatic Track Door, Left Hand.

The advertiser would like to know where you saw his advertisement—tell him.

Dry Steam at Every Throttle

You can easily obtain this important condition in your own engine room by insisting upon

The Stratton Steam Separator

It will deliver dry steam under severe operating conditions, such as the presence of abnormal quantities of moisture, slugs of water, sudden fluctuations, etc.

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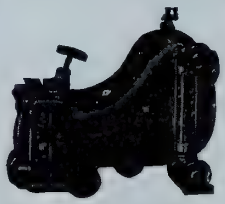

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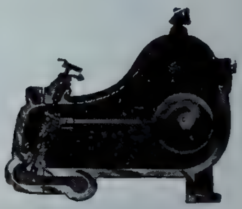

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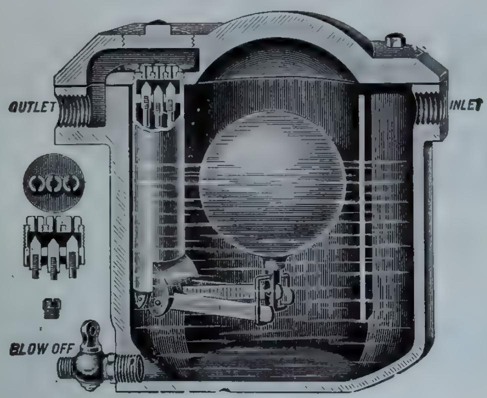

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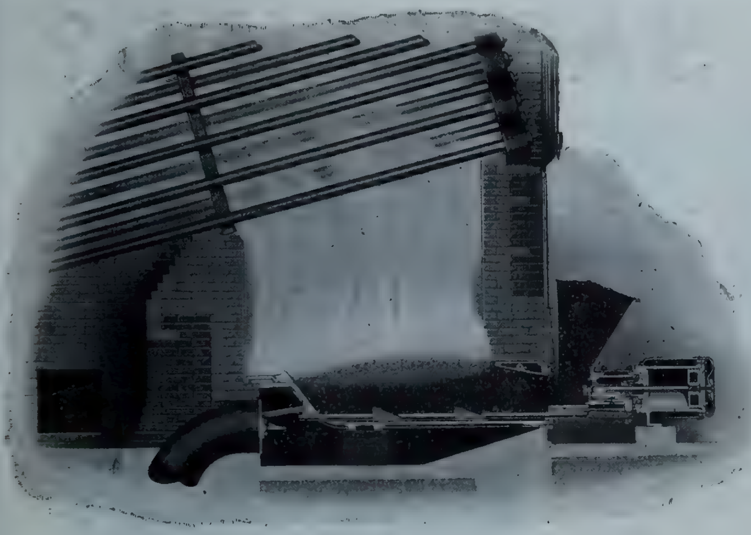

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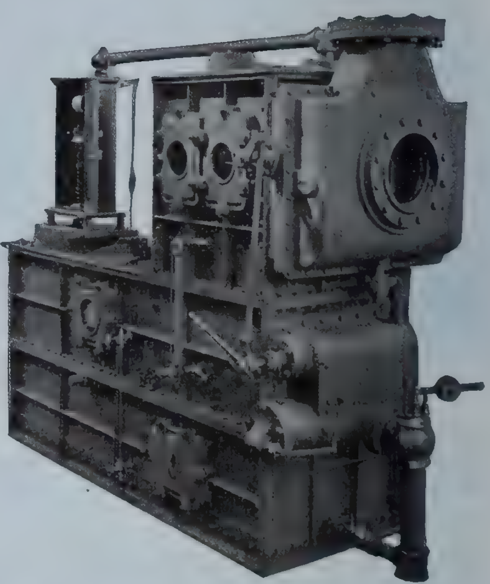

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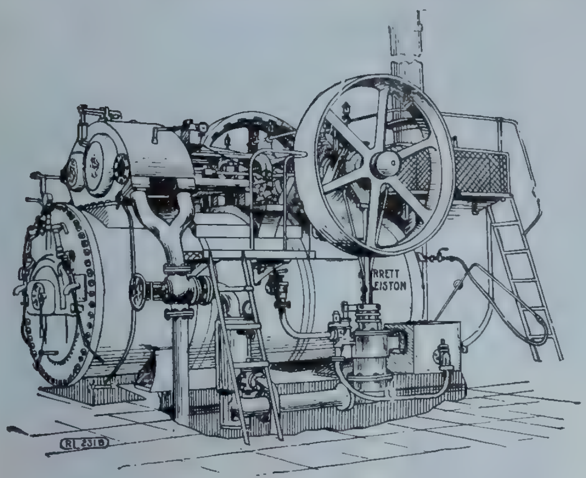

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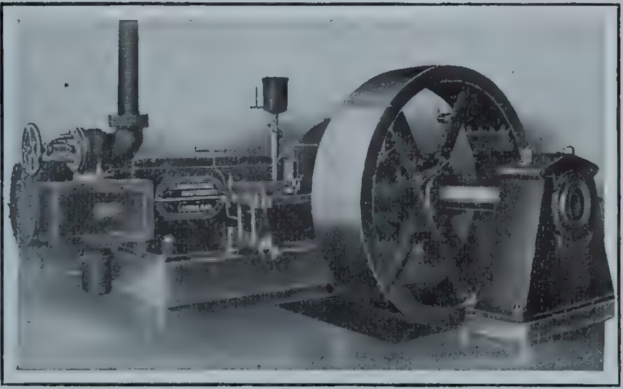

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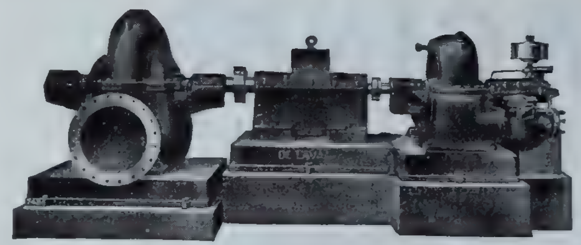

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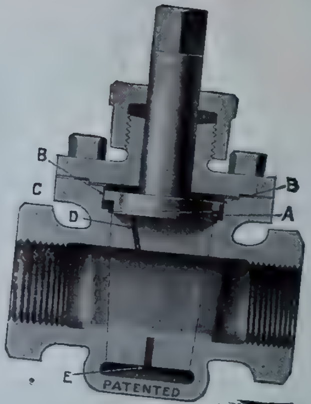

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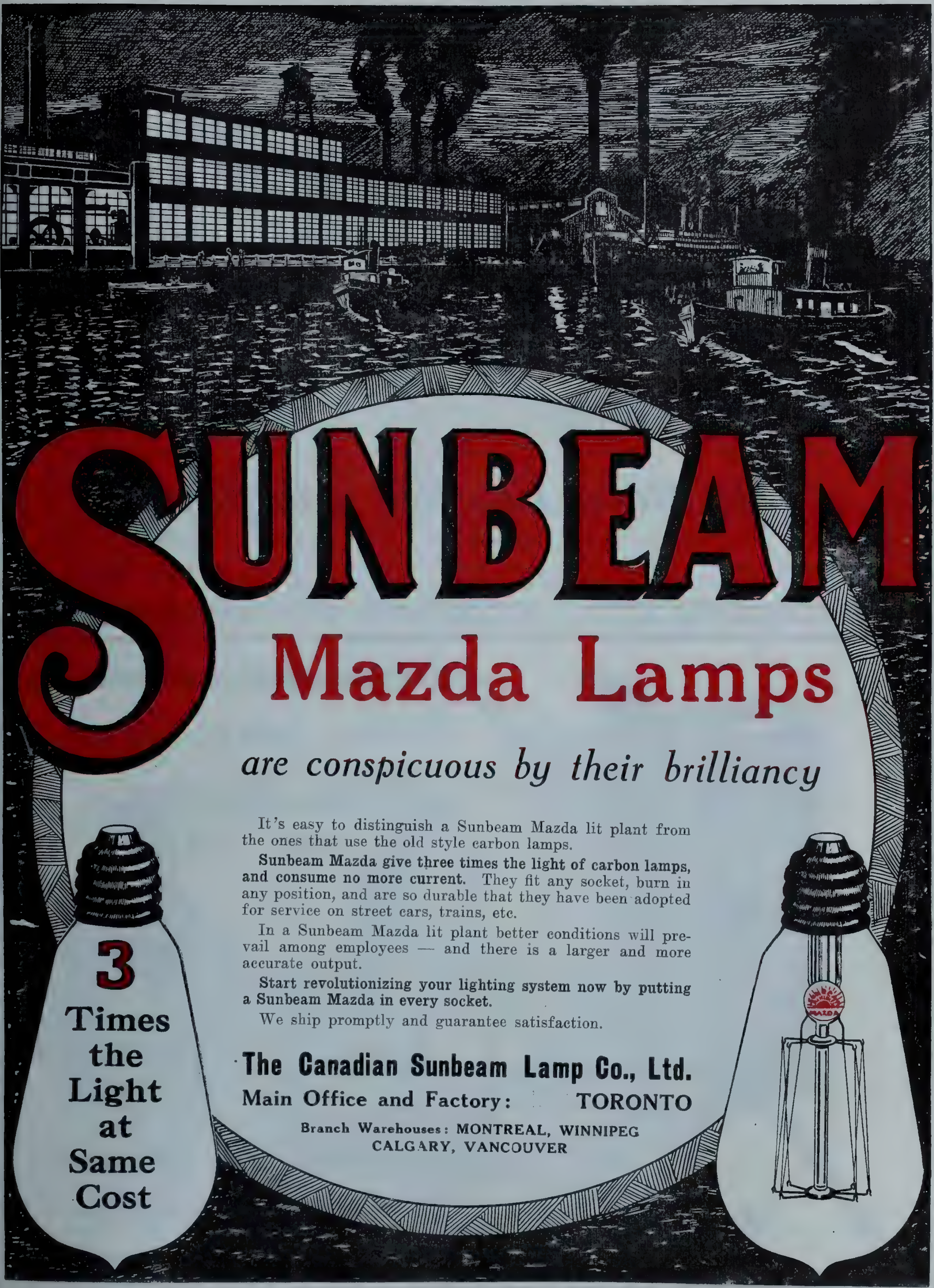

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Canada's soundness needs no argument with you. Canada's ability to weather this storm is not a matter of guesses or hopes—but one of facts and figures.

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SAMSON Turbine Water Wheel

Affords wonderful power, concentrated within a very small space.

In official independent tests conducted at Holyoke, Mass., which is the only recognized testing flume in America, it has shown efficiencies ranging as high as 89.99% at from ¾ to ⅞ gate. **These results are better than any other wheel built in Canada has ever shown,** and on this account we claim that it is the foremost Canadian-built wheel on the market.

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The War

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SAMSON TURBINES are fully equal to European makes, and the war does not affect our delivery.

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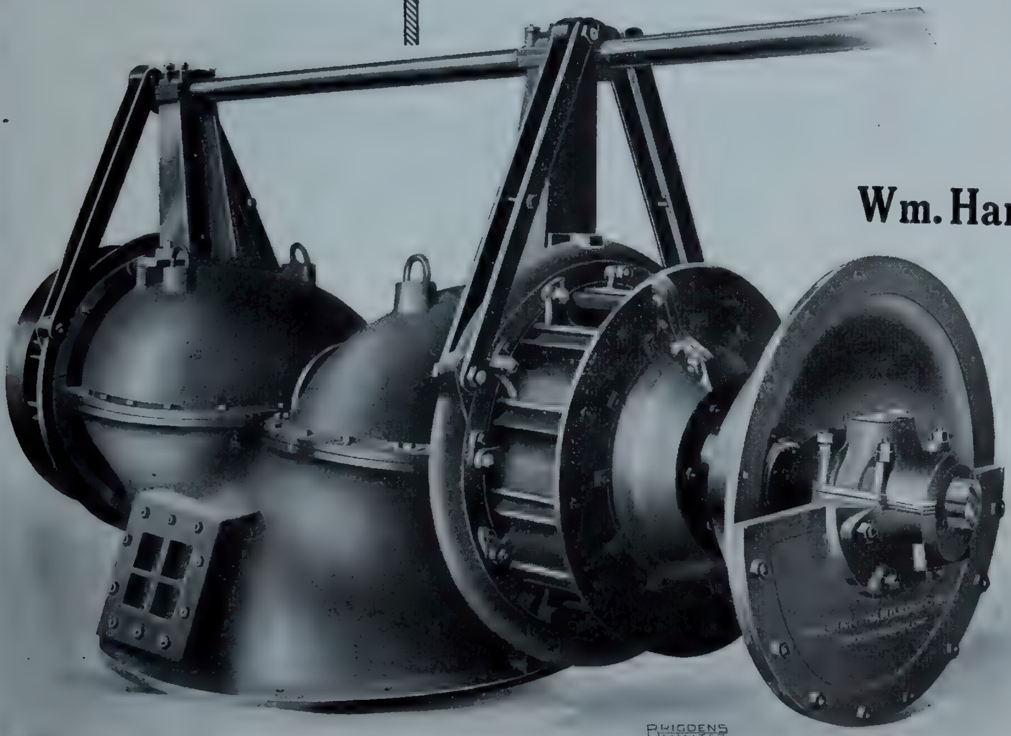

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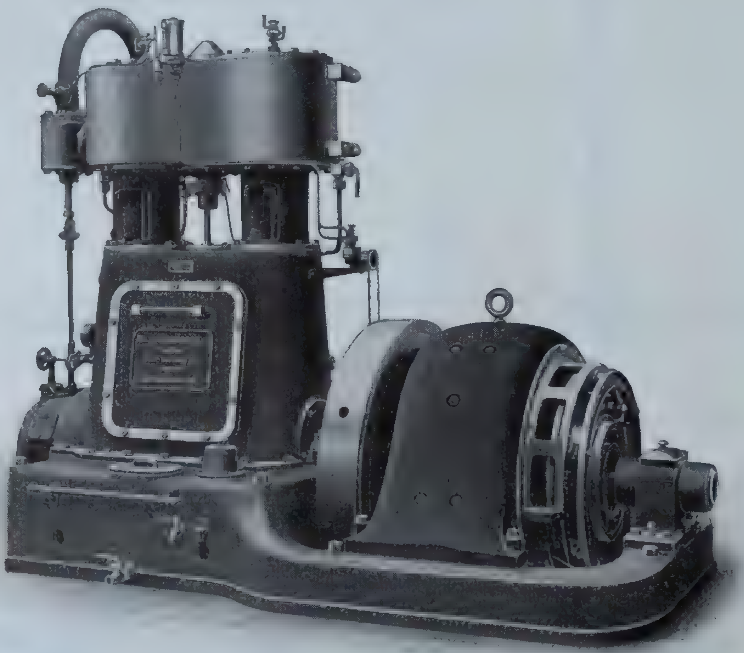

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Quick Revolution, Forced Lubrication, Double Acting Steam Engines

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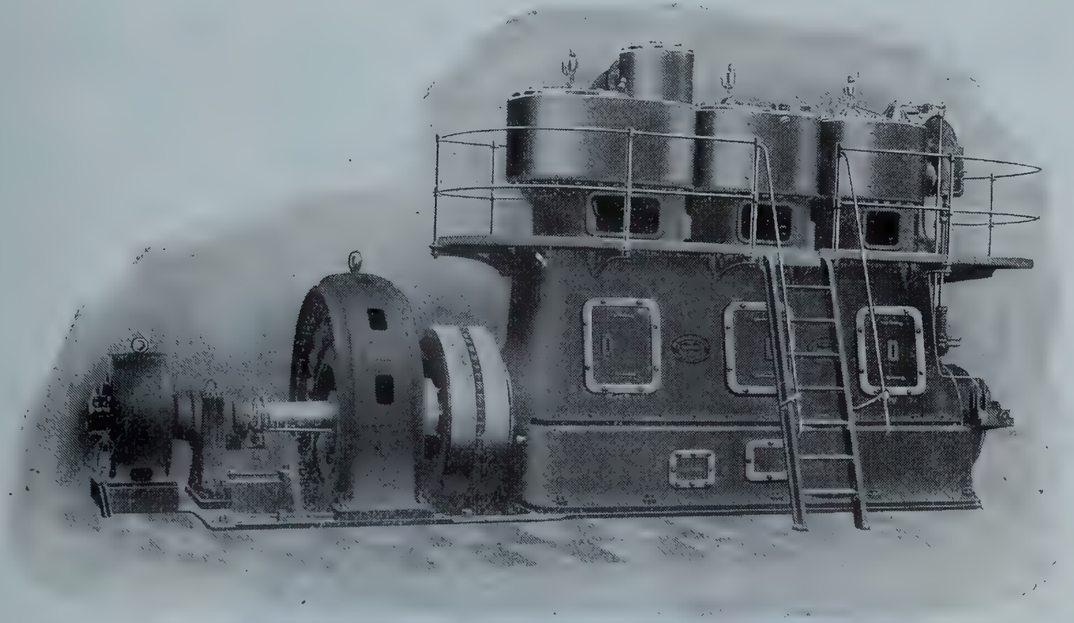

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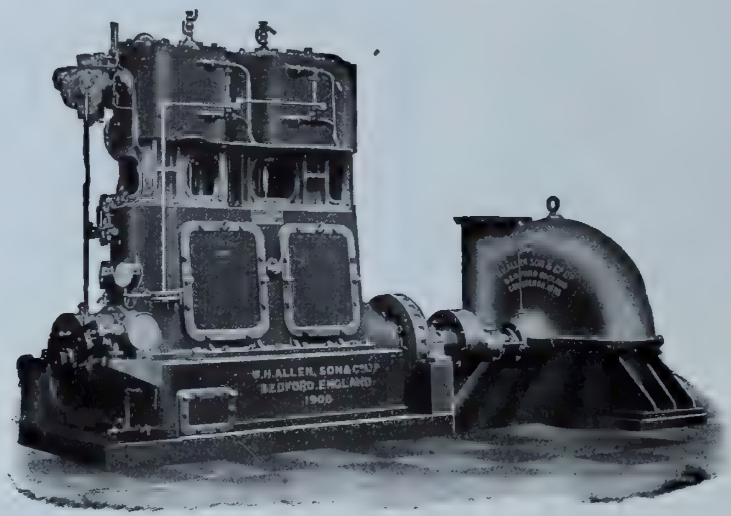

"Conqueror" High Efficiency Turbine Pump, and Two Crank, Compound, Enclosed, Forced Lubrication Engine, 4000 gallons per minute, 65 feet head.

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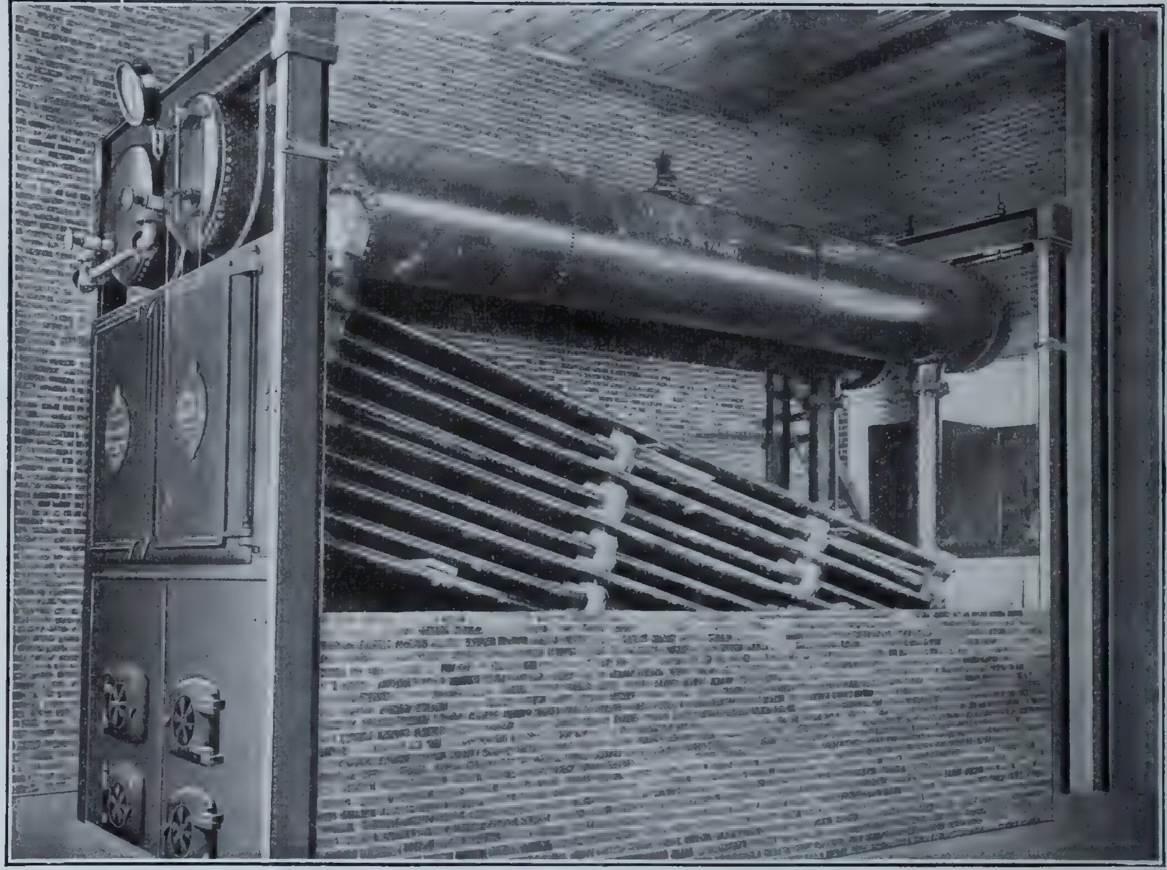

Illustration shows one of our Type A Double Drum, Sectional Water-Tube Boilers being installed at the plant of the Kelsey Wheel Co., Ltd., Windsor, Ont.

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Plant and Equipment of the Ottawa Artificial Ice Co.

Staff Article

In spite of the almost unlimited supply of ice that our Canadian winters make possible of harvesting, the experience of organizations whose purpose is that of ice manufacture goes to show that the public give a preference to the latter, a circumstance no doubt largely due to insured freedom from contamination. Artificial ice manufacturing plants and their equipment have reached a high state of perfection as will be noted from a perusal of the accompanying article.

THE Ottawa Artificial Ice Co. was organized about two years ago to supply the citizens of Ottawa with pure, clear manufactured ice in place of natural ice of doubtful quality. Much success has attended the company's efforts, the demand in summer being such as to be considerably beyond their present plant capacity. Thomas Bate is president and P. D. Lyons secretary and manager of the Company, while among the stockholders are many prominent citizens in Ottawa, including Sir Wilfrid Laurier. C. Lamont is chief engineer.

The plant which was established and equipped for the manufacture of can ice, was completed in May, 1913. It is thoroughly up-to-date, being electrically driven throughout. The nominal capacity is 50 tons per day, but in the endeavor to meet the demand, 18 per cent. in excess of this, or practically 60 tons per day is produced. The water from which the ice is made is drawn from artesian wells and afterwards distilled. Owing to the low rates at which electric current can be obtained it was considered to be more advantageous to run the machinery by electric drive and have only a small boiler to operate the distilling apparatus, than to install a steam-driven plant and use the exhaust steam for distilled water purposes. Consequently, electrical operation was decided on, the only steam-driven machinery being the distilled water circulating pump.

Plant Lay-out and Equipment.

The layout of the plant is shown in Fig. 1. The ice storage room and freezing tank are located in the front part of the building, and directly behind these are the machinery room and the bottling room. In the rear of the building are the boiler room and the distilling and purifying apparatus. The offices are located over the ante-room of the ice storage. Fig 2 shows an interior view

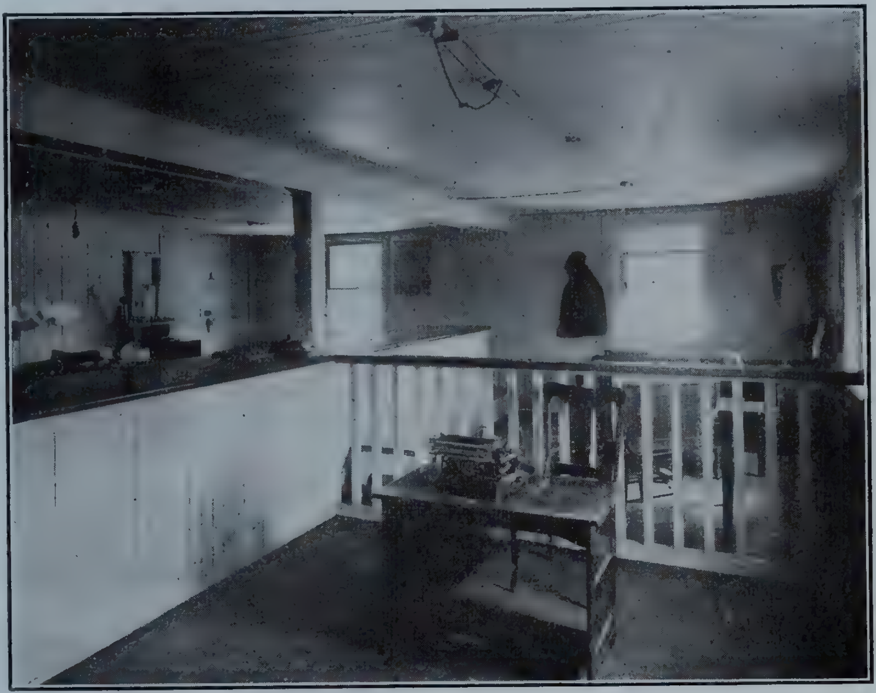

FIG. 2. INTERIOR VIEW OF OFFICES.

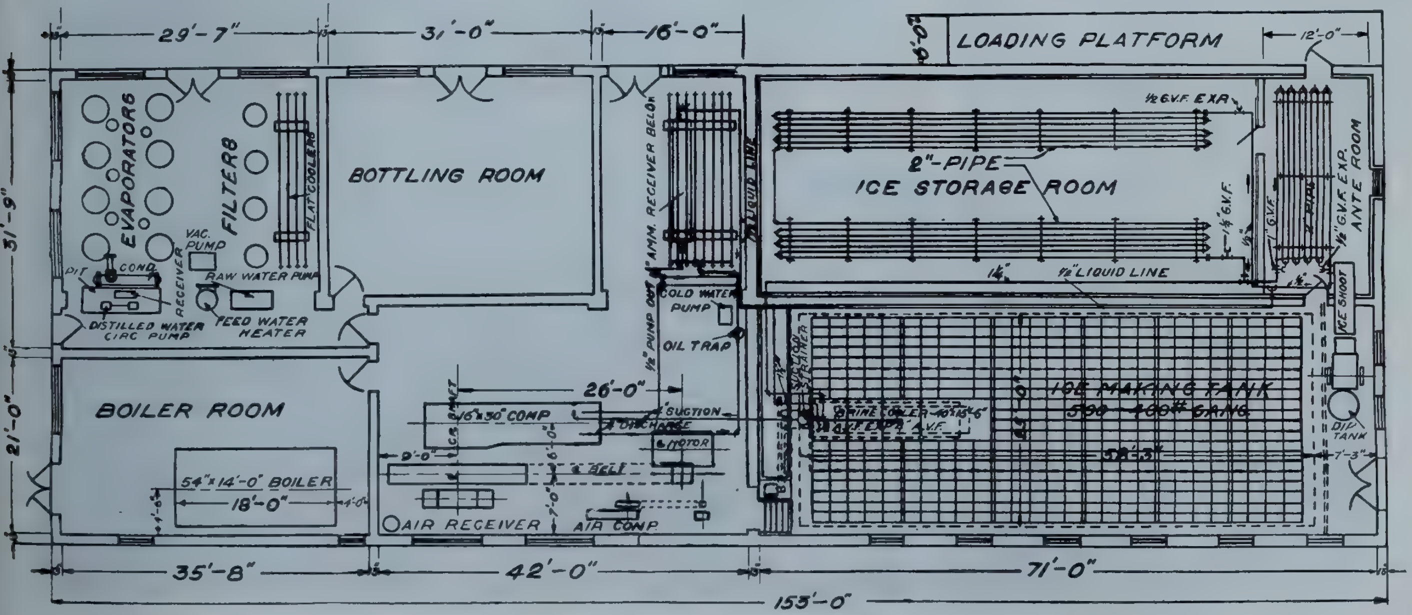

FIG. 1. PLANT LAYOUT, OTTAWA ARTIFICIAL ICE CO., OTTAWA, ONT.

of the offices, and Fig. 3 an exterior view of the plant from the front.

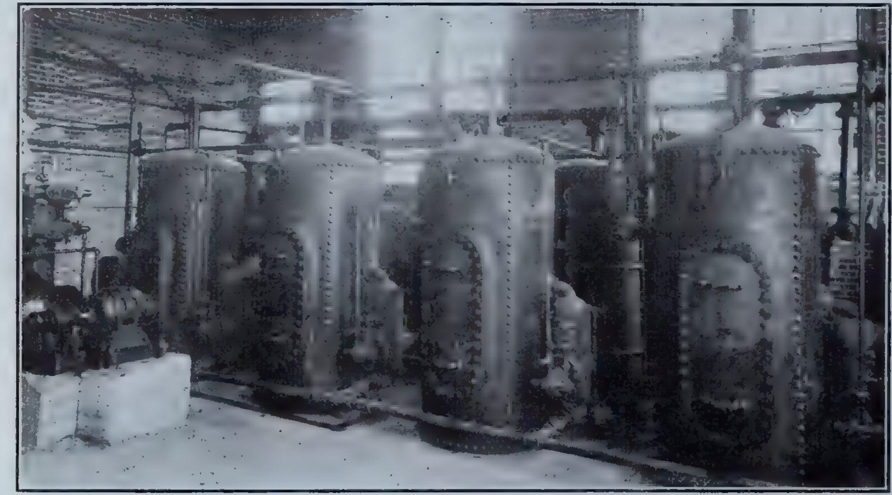

FIG. 4. DISTILLING AND PURIFYING PLANT.

The water distilling or purifying plant consists of a battery of Reilly multicoil 8-effect evaporators supplied and installed by the Canadian Griscom-Russell Co., Montreal, and in conjunction with the evaporators are raw and distilled water circulating pumps, charcoal filters, flat cooler and a Blake-Knowles vacuum pump. The vacuum in the 8-effect system is 27 in. Steam for the distilling apparatus is supplied by a return tubular boiler 54 ins. in diameter by 14 feet long, of 130 pounds per sq. in. working pressure. The boiler was supplied by the Brownell Co., Dayton, O.

Plant Operation.

Most of the water used in the plant is obtained from two Artesian wells, whose water level is 90 feet from the surface. The water is raised to a 8,000 gallon tank at the ground level by means of an air lift, and is pumped from this tank by a Smart-Turner 7 x 8 in. triplex pump driven by a 7½ h.p. Canadian Westinghouse motor. It goes first from the tank to the ammonia condenser and then to the steam condenser in connection with the evaporators. From this line between the ammonia and steam condensers, branches are run to the flat cooler and feed water heater, the feed water heater receiving all the water required for the evaporators by automatic regulation. The flat cooler was supplied by the Triumph Ice Machine Co., Cincinnati, Ohio, and consists of 4 sets of double pipe 20 ft. 6 in. long, by 8 high. The feed water heater is a Massillion type heater, purifier and oil extractor, and was supplied and installed by the Canadian Griscom-Russell Co.

The 4 x 4 in. Dean raw water pump shown in the background of Fig. 5, pumps the water from the feed water heater to the evaporators; the water in the latter being kept at constant level by a float valve. The pump operates at constant speed so that relief for overpressure in the delivery pipe is necessary. It is accomplished by a relief valve with outlet back to the feed water heater. The condensed water from the evaporators is collected in a receiver from

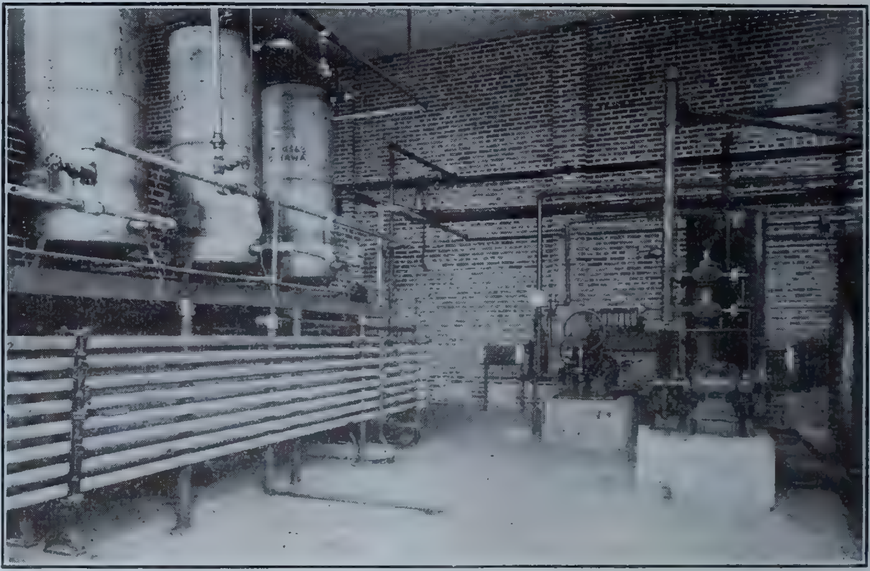

FIG. 5. SHOWING RAW WATER PUMP.

FIG. 3. EXTERIOR VIEW OF OTTAWA ARTIFICIAL ICE CO. PLANT.

which it is pumped by a duplex steam driven pump, Fig. 1, through the flat cooler and filters to a storage tank located above the ice storage room. From the storage tank the water is fed by gravity to two automatic can fillers in the ice tank room, Fig. 6. The flat cooler and the ammonia condenser cooling water supplies have each city water connections, which are used when the well water is not sufficient to supply all needs.

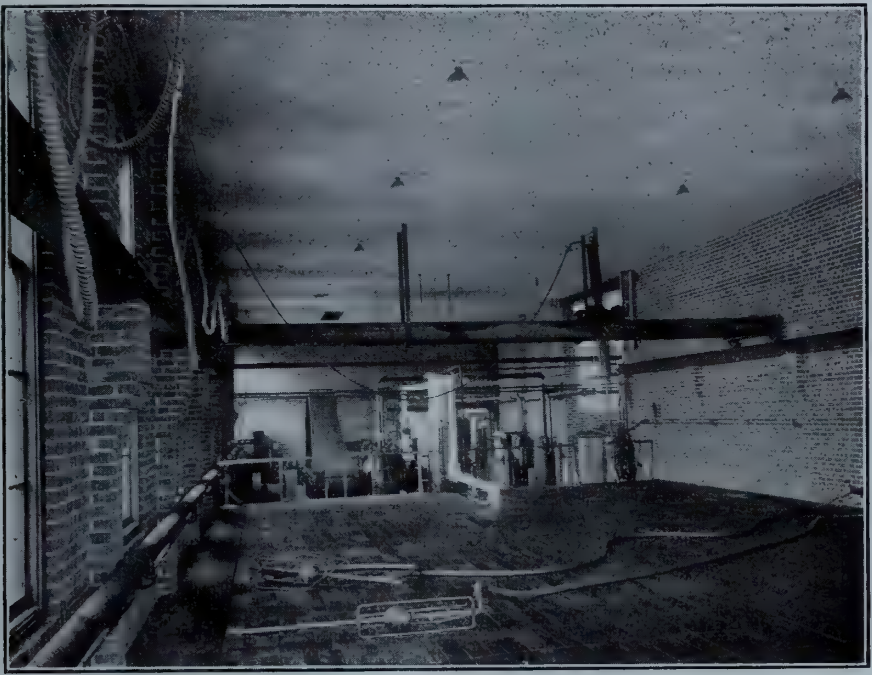
FIG. 6. TANK ROOM AND EQUIPMENT.

Compressor and Cooler.

The ammonia compressor, Fig. 7, is a 16 in. x 30 in. belt driven machine of the horizontal double acting type. It was built and installed by the Triumph Ice Machine Co., is fitted with their geared stuffing box, and runs at a speed of 65 r.p.m. The compressor is driven by a Triumph Electric Co. 150 h.p., 60 cycle, 2 phase, 440 volt induction motor, Fig. 8, running at 437 r.p.m. The ammonia condenser is of the concentric pipe type, with 8 sets of pipes, 20 feet long and 14 pipes high. The liquid ammonia is carried to direct expansion coils in the ice storage room and to a Triumph shell brine cooler in the freezing tank.

The location of the shell brine cooler is shown in Fig. 1. The brine is circulated by two agitators driven by a 10 h.p. Triumph motor. The principles and the great advantages of this system of brine cooling have been set forth in previous issue of **The Power House** and need not be repeated here. It is claimed, however, that the difference in temperatures between any two points in the tank never exceeds one degree.

Freezing Tank.

The freezing tank is 25 x 57 x 5 feet deep, and contains five hundred 400-lb. cans, each block of ice being 11½ x 22½ x 59 ins. With the compressor running continuously, they freeze in forty-five hours. A view of the tank room and its equipment is shown in Fig. 6. A travelling crane with pneumatic hoist runs the full length of the room. At the front end of the room are the skeleton ice dump and dip tank, Fig. 1. The can hoist and dump handle two cans at once. A 10¼ x 10 in. belt-driven air compressor, built by the American Air Compressor Works, Brooklyn, N.Y., supplies the compressed air for the can hoist and for the air lift for the well water. The compressor is driven by a 40 h.p. Canadian Westinghouse motor, 440 volts, 1120 r.p.m. A 9½ x 9½ x 10 in. Canadian Westinghouse air compressor is also installed for use in case of emergency.

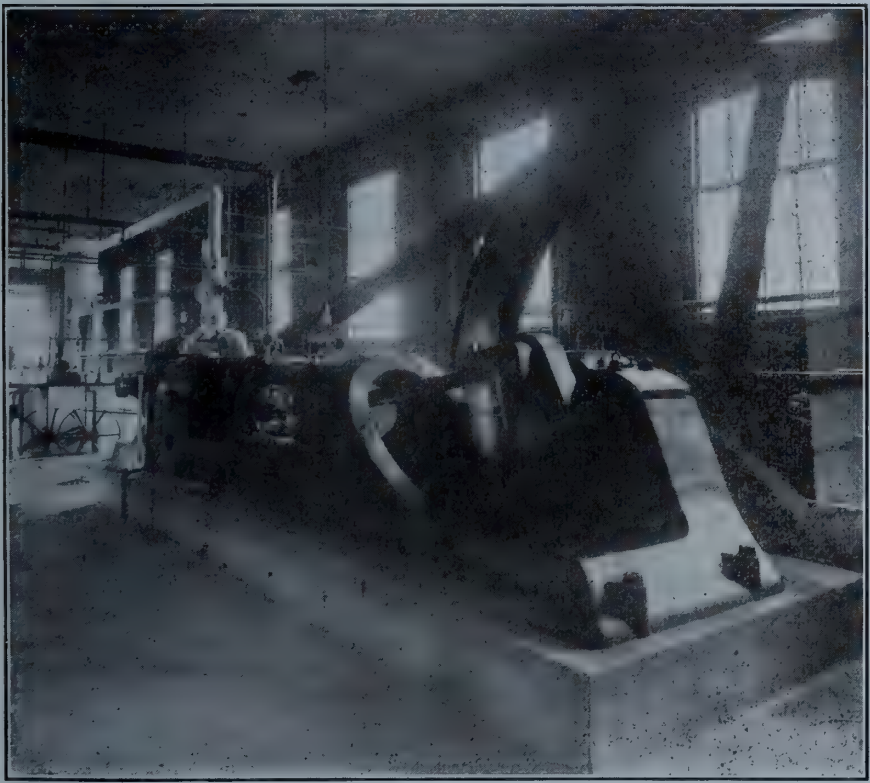
FIG. 7. BELT-DRIVEN AMMONIA COMPRESSOR.

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INCREASED OUTPUT OF ALBERTA COAL

THE very rapid development of the coal industry of Alberta is shown by figures which have just been compiled regarding the operations of coal mines in the province in 1913. Tons of coal mined in Alberta during 1913 numbered 4,306,346, being an increase of 859,997 over 1912. During the past eight years the coal output for Alberta has increased 500 per cent.

The Edmonton district has the largest coal fields, not only in Alberta, but in the Dominion. These areas are being opened up as fast as railway communications and capital make their operation possible. At the present time the Crow's Nest holds first place among the coal producing districts in Alberta, having an output of 1,849,435 tons. Lethbridge comes next with 966,020 tons; Edmonton third with 863,430 tons, and Calgary fourth with 627,461 tons. A large number of new mines were opened up during the year, mostly in the Edmonton coal field. Some of these were closed down again, on account of the fact that at the present time they are not served by railways.

Men Employed.

An increased number of men found employment in the mines of the province during 1913, the total number of men engaged in the mines, both above and below ground being given as 8,608. Machinery is coming to be used more and more in getting out the coal. In the lignite field more than half the coal is mined by machinery, but no machinery is used for coal cutting in the bituminous or anthracite fields. Twenty-nine mines are using electricity. Telephones have been installed in the larger mines, and are proving of great service, both in assisting the management and in obtaining assistance when accidents occur.

Mine rescue stations have been established, two in the Lethbridge district and the other between Coleman and Burmis. Others will be established shortly in the northern part of the province. The stations are equipped with up-to-date apparatus and complete appliances for rendering first aid work very readily, 221 persons having presented themselves for training during the year, while 51 have been granted certificates for proficiency. There were 28 fatal accidents in mines in the province during 1913. Most of these occurred in the smaller mines.

◆

Verdon Cutts & Co., 87 Fargate street, Sheffield, England, have made an arrangement with the Hare Engineering Co., Toronto, to build the Fulton Water Cooled Mechanical Stokers in England for export to Foreign Countries.

STEAM BOILER ACT AMENDMENTS (ONT.).

Upon the recommendation of the Honorable the Minister of Public Works, Province of Ontario, the Committee of Council advise that, pursuant to Section 3 of The Steam Boiler Act, the accompanying amendments be made in the regulations for the construction and inspection of steam boilers as approved by Orders in Council of 29th January, 1913, and June 28th, 1913:

(1)—Section 4 of the regulations to be revoked and the following substituted therefor:—Repaired or rebuilt boilers. Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the regulations by an inspector authorized under the Act. The allowable working pressure for such boilers shall be calculated from the formulae contained in the regulations with such reductions in pressure for depreciation as the inspector's judgment may consider necessary, and an official certificate shall be issued to the owner, stating the working pressure allowed.

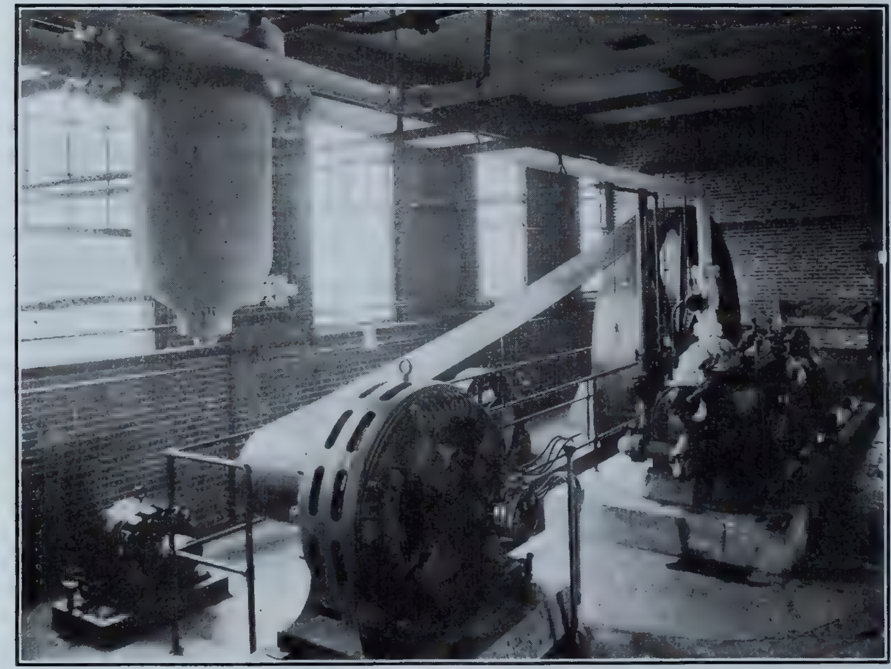


FIG. 8. INDUCTION MOTOR AND COMPRESSOR, SHOWING DRIVE.

(2)—Section 133, sub-section 1, to be amended by striking out all the words after the words "certificate issued" and substituting the following therefor:—"By the Department within one year preceding the date of such sale or exchange." The allowable working pressure for such boilers shall be determined by the inspector from the formulae contained in the regulations, with such deductions in pressure for depreciation as the inspector's judgment shall dictate. The traveling expenses in connection with the inspection of boilers sold, exchanged, or extensively repaired, must be paid by the owner or purchaser of such boilers, together with the inspection fee of five dollars.

(3)—Section 133, sub-section 2, to be amended by striking out the words in the fifth line "and the subsequent sale of such rebuilt boiler" and the words in the seventh line "and the subsequent sale thereof."

(4)—Section 133, sub-section 3, to be amended by altering the word "Minister" to "Chief Inspector."

(5)—Section 135, sub-section 1, to be amended by adding the words "or a boiler to be sold or exchanged" after the words in the third line "are being made."

(6)—Section 136, sub-section 1, to be amended by striking out all the words after "Boilers manufactured outside the province must be inspected," and substituting therefor the following:—"At the place of manufacture by a duly authorized inspector of the Province of Ontario, the Government of Great Britain, or of one of the Provinces of Canada, or one of the United States of America, who shall duly fill out and forward to the Chief Inspector of Steam Boilers, Parliament Buildings, Toronto, the Shop Inspection Report Sheet and Affidavit Form supplied by the Department, together with a fee of Five Dollars ($5.00). These reports shall be examined, and if found to be in accordance with approved design, the official certificate shall be issued by the manufacturer.

(7)—Section 136 to be amended by adding the following as sub-section 3:—"Nothing in sub-section 1 shall prohibit the inspection of a boiler manufactured outside the province when it reaches its destination, if the Chief Inspector should deem it advisable to have such an inspection made by this Department, and if the material or workmanship are found to be unsatisfactory the official certificate may be canceled and a new certificate issued with the necessary deduction in the working pressure."

◆

Roderick J. McD. Parke, a well-known electrical consulting engineer, died on August 25, at his residence, 179 Cottingham Street, Toronto, after many weeks of illness. The late Mr. Parke was the designer of the first long distance transmission plant in Canada—viz., from the Ragged Rapids, on the Severn River, to Orillia. As consulting engineer for the Dominion Government he prepared plans and supervised the lighting of the old Welland Canal from end to end.

Data Relative to Steam Boiler Defects and Failures--V.

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

It will doubtless have been noted by those of our readers who have followed closely the preceding articles of this series that the boiler defects and failures enumerated were just such as may and do occur in more or less aggravated form in any plant. In the present instance, a number of still more striking examples of boiler troubles are exhibited, all of which for the most part will tend to instil in the minds of those in charge, an increased care and watchfulness to prevent the possibility of either experience arising.

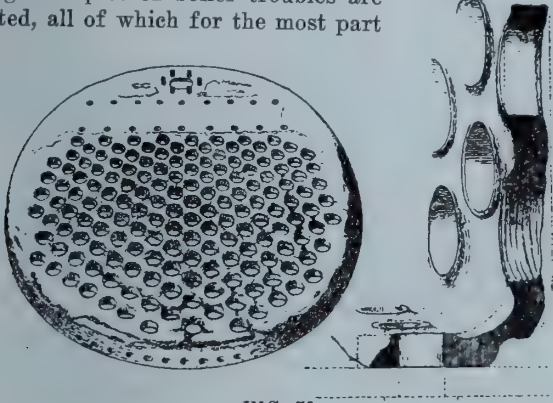


FIG. 56.

Fig. 56 shows the smoke box tube plate of a locomotive. On the water side the plate is corroded from 2 to 3 m.m. around the tube plates, and indicates in the flange for two-thirds of the circumference a deep groove of corrosion. On the opposite side beneath the bottom tubes, there is severe corrosion due to leakages.

Bulges from Overheating and Water Shortage.

Fig. 57 refers to a Parker boiler, in which the fires were severely forced and, owing to the use of a boiler composition, the deposit became separated into pieces, which adhered in patches on the furnace plates of the middle drums of the lower row. Under one of these patches of deposit, a bulge formed 250 m.m. long, 180 wide, and 60 deep. The steel plate, 11 m.m. thick, was fractured at the top of the bulge.

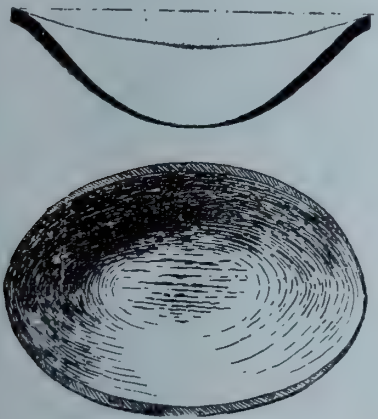


FIG. 57.

In Fig. 58 we have a boiler which was fitted with drums of a special type, whose plates were subjected to very intense heat, the gases impinging directly on to instead of merely licking them. Patches of deposit continually formed on the surface plates and under them bulges were produced. The bulge shown is 250 m.m. in diameter, with a depth of 130 m.m. The plate of steel was 19 m.m. thick and, at the lowest part of the bulge, the thickness was reduced to nothing.

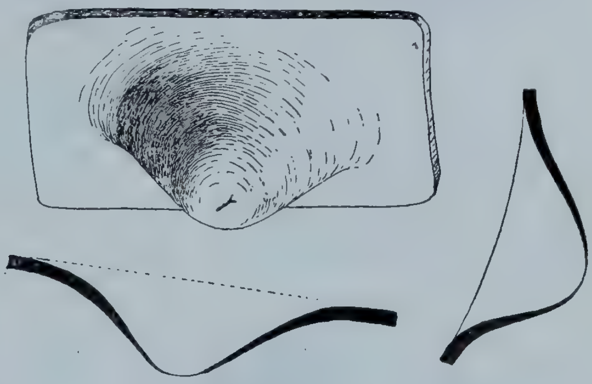


FIG. 58.

Fig. 59 shows a bulge with a depth of 58 m.m. in a Galloway tube; the thickness at the lowest part of the bulge being reduced to nothing. The boiler was installed in a sugar refinery and was rather heavily worked. The feed water contained sugar and oil which formed a deposit on the plates. The first Galloway tube of each furnace became overheated, with the result that a bulge formed.

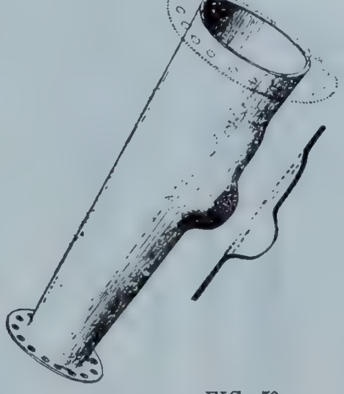


FIG. 59.

Fig. 60 shows a bulge in a furnace plate of steel, 12 m.m. thick, the depth of which was 60 m.m., and at its lowest part having the thickness reduced to nothing.

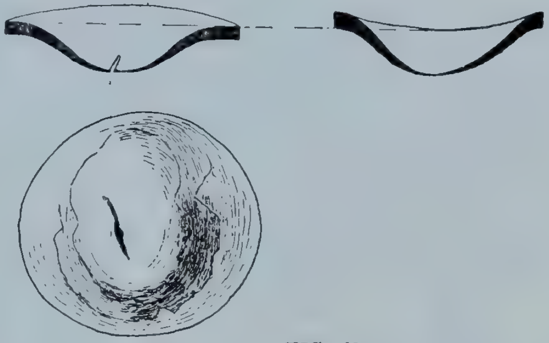


FIG. 60.

Fig. 61 refers to the iron furnace plate of a boiler with feed heater. The plate was 12 m.m. thick, and the bulge, which was about 300 m.m. in diameter, had a depth of only 35 m.m., but it presented externally a series of longitudinal cracks, some of which cross the plate from side to side.

Fig. 62 is a piece of the furnace plate of a semi-tubular boiler with drums fed with very hard water. The tubes are arranged too near one another, making serious cleaning impossible. There were five boilers all alike in the works. The scale detached from the tubes formed patches on the furnace plates and, under these, bulges developed, several being formed each year. The piece illustrated presents two bulges. The more important of the two has a depth of 80 m.m., and is fractured at the lowest part at a point where the thickness is reduced to nothing.

Fig. 63 shows a bulge in the furnace plate of a boiler with single shell. The bulge is fractured at the lowest part and also presents on the inside a series of cracks.

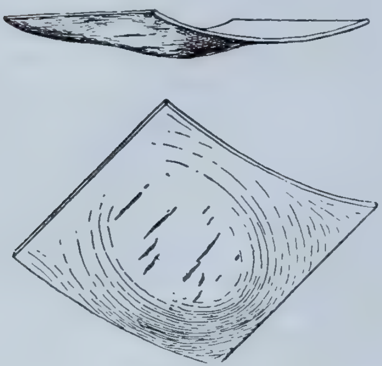


FIG. 61.

Fig. 64 refers to a small crack in the solid part of a furnace plate due to slight overheating.

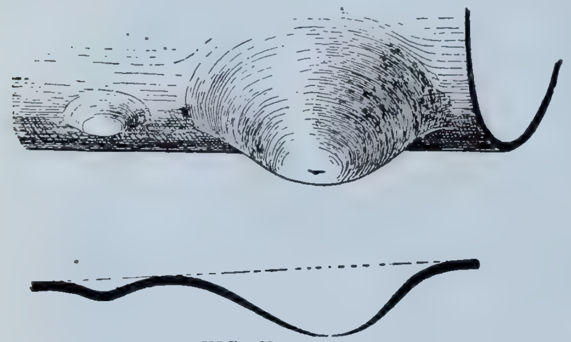


FIG. 62.

Fig. 65 is indicative of the bulge caused by shortness of water in the crown of the header of a Thomas Laurens boiler. The crown of the header is bulged for a length of 500 m.m., a breadth of about 180 m.m., and a depth of 95 m.m. At the lowest part, the plate has retained its original thickness.

Fig. 66 shows a Morrison corrugated flue bulged by shortness of water. One morning the stoker, after having blown off the boiler, neglected to close the blow-off cock. The boiler fires were very brisk, and the fusible plugs failed to act because they were choked up with incrustation due to leakages. It was not until some time after that the noise of the blowing off drew the attention of the engineer to the state of things, and he at once perceived what had happened, and drew the fires. During this operation one of the furnaces collapsed. They had been left uncovered by water for a length of 600 m.m.

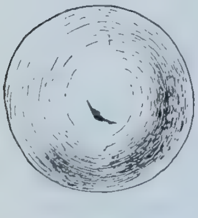


FIG. 63.

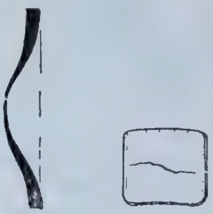


FIG. 64.

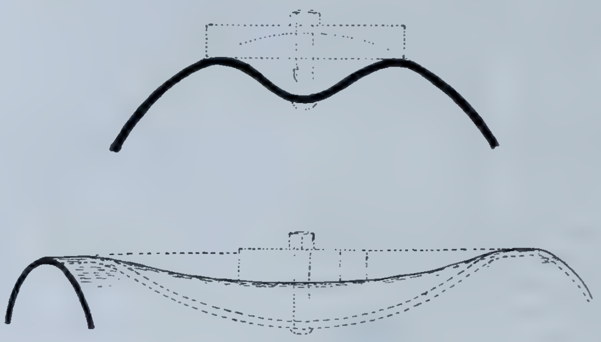


FIG. 65.

Fig. 67 illustrates a series of cracks in the solid plate caused by slight overheating of a plate of bad quality.

Fig. 68 shows a tube from the lower row of a multitubular boiler in a sugar refinery. Owing to the presence of sugar in the boiler, the tube became overheated and gave way in the furnace, extending downwards for a length of about 400 m.m. No elongation was observed at the place of the fracture.

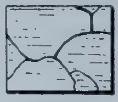


Fig. 67.

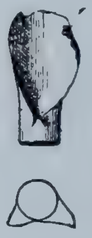


FIG. 69.

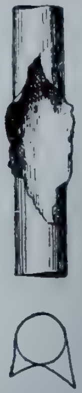
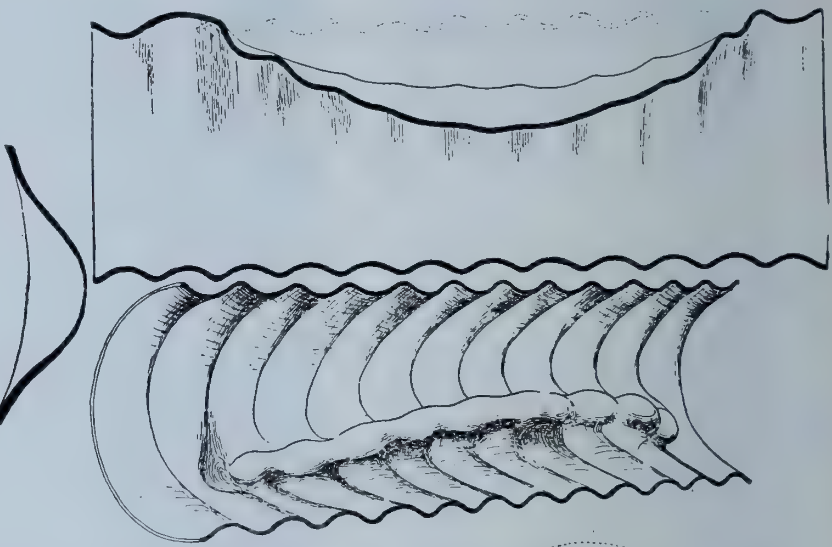


FIG. 68.



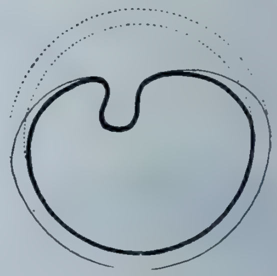


FIG. 66.

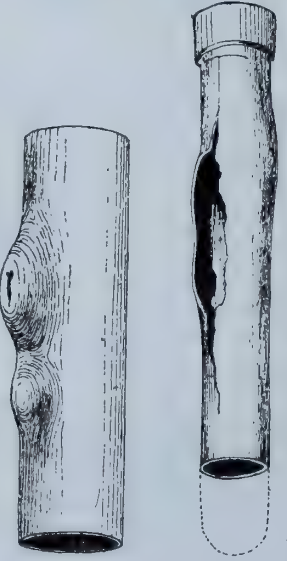


FIG. 70.

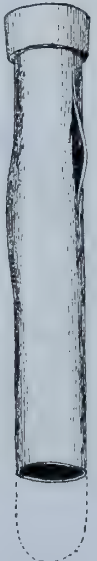


FIG. 71.

Fig. 69 refers to a tube from the lower row in a multitubular boiler which exploded owing to overheating under a layer of deposit of 5 m.m. thick. At the fracture, the length was increased by about 20 m.m. Further, at the side of the fractured part, a certain number of cracks were developed.

Fig. 70 shows bulges caused by a greasy deposit in a tube of the lower row of a multitubular boiler, and Fig. 71, that of a multitubular boiler completely choked up with deposit for a length of about 560 m.m.

Boiler Room Efficiency and Task Setting for Firemen[*]

By Walter N. Polakov

The object of the accompanying paper is to outline a method for the accurate determination and permanent attainment of maximum economy in daily boiler-room practice by the task-setting method. The problem involves a knowledge of the conditions under which maximum operating economy can be obtained and the determination of the factors which will secure the permanency of these best conditions.

The elements affecting the choice for or against task work are so numerous that they cannot all be mentioned. The essential thing is that some element of advantage to the workman be introduced sufficient to overcome actual or imaginary disadvantages believed by the men to exist as a result of the new state of affairs. This advantage takes the form of a sufficiently attractive and generous bonus to be paid for willingness to learn the new way and to continue to observe the instructions. Actual accomplishment of the task and consequent earning of the bonus means the adjustment of certain conditions concurrent with the adjustment of others. This adjustment being under the control of the employee is a physiological process principally depending on (a) the will power of the man, and (b) physical fitness.

The man for whom a certain task is assigned must strive to accomplish its aim. The exercising of the power of will is a threefold process: First, the man must have a desire; secondly, he must make a choice of ways and means; and thirdly, he must perform necessary actions. The workman's desire from necessity is to earn his living at least; next he has to choose whether he shall work under instructions as set forth in the standing order and instruction cards for the compensation offered; and lastly, he has to act according to his decision in order to satisfy his desire.

As a rule, the workmen feel that the adoption of a new method will impose an undue strain, but it is comparatively easy to overcome this misconception with the firemen from the fact that greater efficiency means less coal to be shoveled. On the other hand, the new conditions require the men to give their attention to instructions and the indications of the apparatus, which diverts them unpleasantly from chatting at leisure with their fellow-workmen. This forms a more serious obstacle to their quick decision in favor of new routine than anything else.

Cases are not infrequent where the men, particularly those more or less in authority, take offence at scientific study and prefer to fight it or even quit rather than admit the advantages of the new practice. Temperament usually determines the vigor of the opposition. Social conditions occasionally influence a man's choice for or against the new regime. If a person who is admired by his associates happens to decide against task work, he is liable to influence the choice of his friends and acquaintances very materially. Members of labor unions are more apt to disfavor task work, while socialists are strongly in favor of it, feeling that the scientific method of management helps to solve the problem of nationalization of industries.

Determining Amount of Bonus.

In order to determine the amount of bonus, there must be two limits established—a maximum and a minimum. The maximum bonus should be equal to the amount of net saving accomplished under given circumstances, while the minimum bonus is, of course, equal to zero. When the bonus to be paid actually reaches either of these limits it loses its usefulness since it loses its stimulating effect—with the management, if the maximum, and with the men, if the minimum. Since in an average boiler house the task results in about 25 per cent. saving on the coal bill, while the fireman's payroll is from 10 to 15 per cent. of the coal bill, it is evident that there is a considerable latitude for adjustment of bonus.

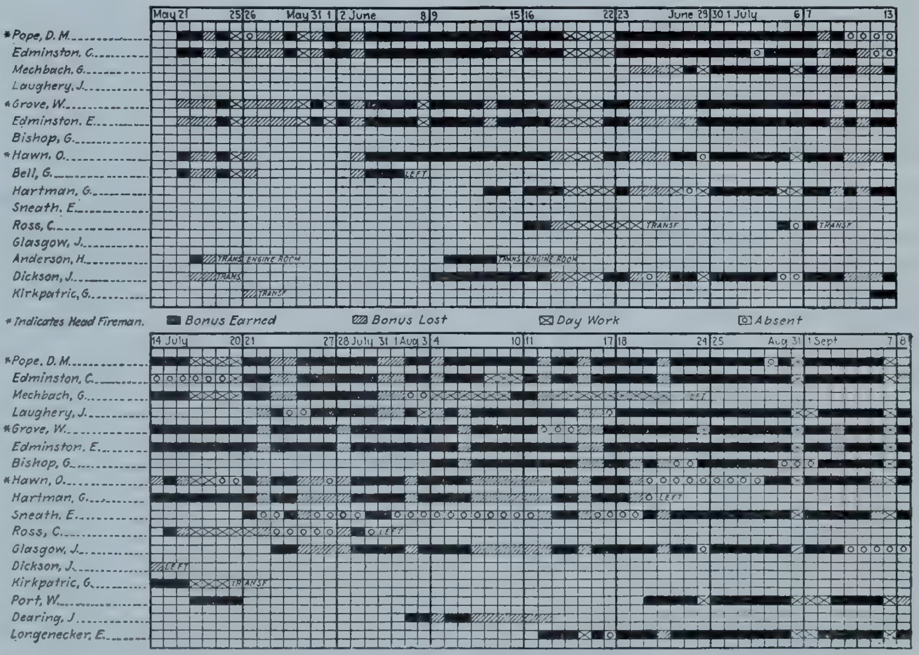


FIG. 7. GRAPHICAL BONUS RECORD FORM.

After the choice has been made in favor of task work, however, as a result of the stimulus offered, the third element, proper action, is yet far from being secured. To act in the chosen direction one must know how the desired result is to be accomplished. Lack of sufficient information necessarily produces a strong perception of uncertainty coincident with suffering. In the case of firemen, the success of attainment of the task is determined by detailed, patient, and prolonged training and instructions, and as such this is the most important function of the management. A dummy furnace was found to be an excellent means to break in the green hands.

Maintaining the Fireman's Bodily Efficiency.

Although the above requirements of additional compensation and exhaustive training for stimulating men's will to co-operate with the management in attainment of the state of high efficiency are imperative, they alone are insufficient. The physical conditions under which the men have to work must be so arranged as to insure the fullest preservation of their strength, health, and physical faculties. The opposition exercised by some labor organizations in instances where greater efficiency is demanded from the workingmen without adequate safeguards to their vitality and ability to work is a just and well grounded fight against the short-sightedness of some self-termed efficiency experts.

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[*] Part III. of a paper read recently before the American Society of Mechanical Engineers.

In a boiler house, the amount of work per man per hour is constant, and cannot be increased without knocking down the efficiency to a ridiculously low figure, but the number of foot-pounds of work can be reduced in an inverse proportion to the increase of efficiency, so that the question of preservation of a man's health, etc., eliminates any consideration of overspeeding. The conditions which then remain for consideration are (a) temperature of room; (b) ventilation (dust and draft); (c) lighting; (d) drinking water; (e) restful seats; and (f) sanitary washrooms.

Service Conditions.

One familiar with the common layout of a power plant cannot over-emphasize the importance of the above conditions to enable the men to live up to their task day in and day out. While engine-rooms not infrequently offer very pleasant and sanitary surroundings, boiler houses, the most important part of any plant, are so built as to make them unbearably cold in winter and uncomfortably hot during the summer; ventilation apparently serves either to fill the lungs with coal dust or to chill the perspiring men after cleaning their fires. Lighting is an unusual luxury, so that after looking into the furnace no man could read his gauges or examine anything around the boiler. Good drinking water is rarely provided, and restful seats with backs (seats without backs are equal to no seat at all) were never found by the writer in any boiler house. Yet the mere fact that the firemen, if provided with seats having backs, can get through the cleaning of fires in 18 minutes per 100 sq. ft., while without them they consume at best 24 minutes, apparently should convince any unbiased mind.

On the contrary, the absence of an elementary condition of comfort in a working place where the men spend the better part of their lives is more harmful to the employers than to the employee. The petty annoyances and feelings of discomfort divert the attention of the men from the performance of their duty to means of avoiding the annoyance or harm. Steady attention on the part of the fireman is much more important than is generally realized. A psychological test conducted by the writer on the effect of the occasional drop of attention with the same individual and with individuals possessing different degrees of this faculty proved that physical condition and strength being constant, the boiler efficiency percentage is in an almost direct proportion to the degree of attentiveness of the fireman.

Determining Task Harmfulness.

With healthy, sanitary and pleasant surroundings as a sufficient criterion for judging whether the man's task is harmful, a simple and apparently reliable method was devised by the writer. It is evidently beyond the means of ordinary time study to define whether or not the possible output in a unit of time is a safe one from the viewpoint of the preservation of the individual and the nation. The problem in itself is twofold:—(a) Strain per unit of time in foot-pound per square inch of cross-section of a muscle, and (b) number of time units at work. As in every case where more than two variables are evolved, the maxima are determined by the limiting conditions of variables, and the constant safe limit can be reached either by a comparatively great strain during a short time or a less intense strain during a longer period. If t and s are time and strain respectively, the equation

$$\frac{d \times ct \times s}{d \times t \times c's} = 1,$$

if differentiated, illustrates the problem; yet, whether factor c for time or c′ for strain has the same numerical value the experiments alone are able to show. More study along this line is needed.

In our experience we adopted, in addition to time studies, a careful investigation of fatigue, both mental and physical, and measurements of the vitality of the men affected by various conditions of work and number of working hours per day. No task is reasonable unless the workman can fully regain his loss between quitting time and recommencing work the next day, and during a sufficiently long period of observation a man should be able to gain or at least not lose anything in his vitality. Observations should cover at least four factors: (a) Weight of body; (b) blood pressure; (c) temperature of body; and (d) pulse. The blood analysis while considered desirable is too cumbersome to make, and other indications being favorable, can safely be omitted. Almost unanimous statements of those observing the task work performed in a great variety of industries assert that men are gaining in health and spirit, but scientifically definite data alone could prove this fact beyond any doubt.

The Time Element.

Finally, the time element in relation to task setting for men, particularly if the work requires a considerable strain, must be settled by examination no less careful than the study of the time rate of driving boilers. When, however, as in the case of firemen, both physical strain and attention are required, it was found that with strong, healthy individuals the limiting factor on number of hours of profitable work is set not by physical exhaustion, but by weariness of spirit. Other conditions being equal, a fireman on a 12-hour watch is found to be about 4.5 per cent. efficient than the same man on an 8-hour shift.

This time-limiting factor on human efficiency, taken in conjunction with a scientific certainty in determination of the most advantageous thermal efficiency, formed the grounds on which the writer rejected the sliding scale of bonus rate results exceeding the task set by various degrees. The task set must be so little below the most advantageous point that it could be reached with greatest benefit to all concerned, and it is not desirable from economical aspects either to fall short of or considerably to overreach it. Offering extra compensation for excess of the task requirement means in final analysis either that the investigator did not determine both limits, or that the management tempts a man to do more than the average employer dares to ask directly.

Employer and Employee Co-operation.

The example of efficient co-operation between employer and employee in the power plants of public utility corporations here referred to demonstrated the value of the above principles for setting task and accomplishing the predetermined results in firing boilers. A diagram showing cost per kilowatt hour of fuel relative to firemen's payroll and bonus before and after adoption of scientific basis for firing, presented, outside of an interesting reduction in cost due to the change of method, another feature also of no less importance—namely, that the unit cost remained practically constant, while previously it fluctuated considerably.

The writer does not claim to have made any new discovery or exhaustive treatment of the technique of the question. The undertaking of presenting to the profession a brief outline of systematic method of task setting for one particular job can be considered fairly fulfilled, if the necessity of thorough scientific research and accumulation of available data for further enlightenment of the many still obscure facts and their co-ordinations is sufficiently demonstrated.

◆

Peat Fuel.—Encouraging reports of the development of the peat fuel industry have been received from Alfred, Ont., where the Canadian Peat Co. is operating. This is the plant formerly operated by the Mines Branch of the Dominion Government. For several years a limited quantity of this fuel has been shipped into Ottawa, and has given the utmost satisfaction to all who have used it as a fuel for either kitchen ranges or open fireplaces. The company is now operating night and day and expect to have several thousand tons for delivery in Ottawa this season.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

LARGE TURBO-GENERATORS.

SOME particulars were recently given in The Electrical Review and Western Electrician of the new electric power generating station of the Philadelphia Electric Company, which are of special interest in view of the fact that it will be equipped with the largest turbo-generator in the world. It is a polyphase unit of 35,000 kw. capacity, built at the works of the General Electric Co., Schenectady, together with another almost equally large unit of 30,000 kw. capacity. The 35,000 kw. 60-cycle turbo-generator is wound for 13,200 volts, three-phase. It has six poles, and will run at 1,200 revs. per minute. The amperes per phase at 90 per cent. power factor are 1,460 and the internal reactance 10 per cent. The exciter is a direct-connected 150 kw. six-pole 250-volt shunt-wound machine, operating at 1,200 revs. per minute. The 30,000 kw. 25-cycle alternator is wound for 13,200 volts, three-phase, and runs at 1,500 revs. per minute. It is a two-pole machine, the amperes per phase at 100 per cent. power factor being 1,313. The internal reactance is 8 per cent., and the external reactance 4 per cent. It has a direct-connected 250-volt shunt-wound exciter of 110 kw. capacity. It is a six-pole machine, operating at 1,300 revs. per minute.

Each of these machines have temperature coils located permanently in the stator windings and connected to recording instruments located at the switchboard. This enables the operators at all times to know the temperatures of the high tension windings, which is an additional safeguard in the operation of the machines. The armature insulation tests (200 per cent. or normal voltage) for each alternator are 26.400 volts, and field insulation tests 1,500 volts. The 500 kw. turbo-exciter set comprises a Curtis steam turbine operating at 5,000 revs. per minute, and a geared shunt-wound six-pole 250-volt direct current generator operating at 900 r.p.m. The turbines will be supplied with superheated steam of 215 lbs. pressure at the throttle and superheat not to exceed 200 deg. Fah. through a 20-in. throttle valve.

The main bearings of each machine are 24 in. diameter by 52 in. long, and are water-cooled by the circulation of 60 gallons of water per minute for the 30,000 kw. machine and 100 gallons per minute for the 35,000 k.w. machine, both at minimum pressure of 20 lbs. per square inch from turbine-driven pumps. For lubrication of turbine bearings 40 gallons of oil per minute will be required at minimum pressure of 30 lbs. per square inch.

Condensers.

The condensers, which are the largest ever built for stationary practice, will be of the two-pass radial-flow surface type, each containing 50,000 square feet of cooling surface. The tubes will be 1 in. diameter, 18 B.W.G. thick, and are arranged eccentrically within the shell in circular rows. The air will be removed from the centre in order to give the steam a minimum path of flow through the condenser tubes. By means of the counter-flow principle, the condensate will be allowed to pass down over the hottest tubes, and will be removed at a temperature within a few degrees of the exhaust steam. The circulating water to each condenser is supplied through three-rotor centrifugal geared turbine-driven pumps. For each generating unit there are two of these pumps, with a maximum capacity each of 37,500 gallons per minute. Besides these, there is provided one additional pump of like type and capacity, as a spare unit coupled for emergency service to either condenser. The reduction gear used for these pumping outfits is of the well-known herringbone type with a gear ratio of 9.1, the turbine operating at 2,880 revs. per minute, and the pump at 320 revs. per minute. The injection water, which will be delivered to the condenser through a 48 in. pipe, enters at the bottom and discharges from the top through a pipe of similar size, and the end of this discharge pipe will be sealed so as to form a perfect syphon system.

* * *

C. J. Gibson has been appointed Town Engineer of Bowmanville, Ont.

ELECTRIC MOTOR VENTILATING FAN BREAKDOWN.

THE load which an electrical machine can carry seldom depends upon the mechanical strength of the parts; the limit being usually set by some electrical factor. In direct-current machines this was, at one time, commutation, now it is heating; formerly machines were large in size and very open, now they are much smaller, more compact, and frequently more or less closed in. The advent of commutating poles has raised the maximum load at which a given machine will commutate satisfactorily to 50 or 100 per cent. above that at which the heating is kept within permissible values. Other types of machines will also carry very heavy loads momentarily, but the heat generated when the load is continuous necessitates the steady load to be kept within much lower limits. The modern problem is, therefore, to carry the heat away by a continuous supply of cool air. For this purpose many machines are now fitted with fans attached to the armature or rotor spider. The fans are of various designs, but generally consist of sheet iron blades attached by screws to a portion of the casting or by rivets to a sheet iron ring.

The blades are subject to a considerable stress through centrifugal force which must be taken up by the blade fastenings, and if these are not secure, the blades will be torn away. This occurred recently to a 100 h.p. motor running at 730 revolutions per minute, says Vulcan. The fan consisted of sixteen blades and thirteen broke away. The motor was pipe ventilated, the outlet pipe was vertical and six feet high with a right angle bend at the top projecting horizontally a distance of two feet. The blades were attached by two ⅛ in. rivets to a sheet iron ring at one end and by two ¼in. screws to a cast iron hub at the other end. The rivet holes in the blades were only ⅛ in. from the edge of the metal; in some cases the ⅛ in. of metal was torn through, and in others the rivet heads were forced through the holes. The ¼ in. screws did not give way in most cases, but the blades were torn across. Although the fan blades were ripped off in such a violent fashion, no damage whatever was done to the windings or other parts of the motor.

ROLLING MILL STEAM ENGINE.

A steam engine of 1700 mm. bore, 1400 mm. stroke (67 x 55 in.) and 100 to 130 r.p.m., installed for driving a three-high rolling mill, was recently tested with results as follows, according to Stahl und Eisen. The steam consumption was guaranteed by the manufacturers at 5.2 kg. (11.44 lb.) per i.h.p.-hr. at seven atmospheres gauge pressure at the engine, and 300 deg. C. (540 deg. F.) superheat. After the engine had been in operation about six months it was decided to determine its actual steam consumption, and to do this a brake test was undertaken, with the engine working for 3 hours at an average rate of output of 3000 h.p. This test was followed by a second test with a load of 1820 h.p. on the engine, which was required in order to establish how consumption varied with variations of load. The results follow:

	Test 1	Test 2
Average speed, r.p.m.	97.8	102.0
Length of test, hr.	3	1.5
Average pressure at the engine, atmospheres gauge...	6.3	7.03
Steam temperature, deg. F...	541.4	553.8
Vacuum, per cent.	87.5	89.9
Average output, i.h.p.........	2982	1822
Steam consumption, as measured, without condensation, lb. per l.h.p.-hr.	12.82	10.12
Steam consumption reduced to 7 atmospheres gauge pressure, 540 deg. F. superheat, 90% vacuum, without condensation, lb. per h.p.-hr...	11.66	9.9
Power consumption of the condenser plant, per cent...	3.9	6.3

FUEL FROM ASHES.

THERE is hardly a boiler installation says **The Power User**, in which an appreciable percentage of fuel does not fall through into the ashpit when but partially consumed. In very few cases are the carbon contents of such coked material less than 10 per cent. or 20 per cent., and in many cases, particularly where boilers are working under heavy load, this figure rises to 60 per cent., or 70 per cent., so that, even assuming that only 5 per cent. of the total weight of coal thrown into the firebox escapes into the ashpit unburnt, there is wasted fifty tons of coal—worth, say $150—in every thousand tons of fuel nominally burnt below the boilers.

With a view to recovering this fuel economically, experiments have recently been made with a simple process of gravitational separation. A liquid mixture is made to have a slightly greater specific gravity than coal, and into a tankful of this fluid the ashes are thrown. The pieces of coal and coke float on the surface, but the ashes, being heavier, sink to the bottom of the tank, and are removed thence by a screw conveyor.

During a practical trial of this system, no less than 800 tons of coke were recovered from 2,000 tons of material collected from boiler ashpits. Of this coke 500 tons was between ¼-in. and 2 ins. in size, and hence suitable for immediate re-use; the remaining dust (all less than ¼-in. gauge) was suitable for the manufacture of briquettes, or could be used in dust-fired boilers or in gas producers.

Not only does the above process yield a quantity of fuel from refuse, the disposal of which has hitherto been a more or less costly matter, but, further, it yields "clean" ashes suitable for use as ballast in concrete (not to be used in contact with steel work) or for filling-in purposes, etc.

STEAM TURBINE LUBRICATION.

EXPERIENCE has shown that the oils most suitable for steam turbine lubrication are pure mineral oils free from acidity and soaps, and incapable of emulsifying when shaken with warm water; for even with a well-designed bearing, good results can only be obtained when proper mechanical provision has been made for lubricating it efficiently with a lubricant suitable for its particular purpose. Assuming that facilities are given for the oil to spread over the whole of the bearing surfaces, the best results are obtained by the use of a lubricant that will just keep the moving surfaces apart, under the maximum pressure to be expected, even when the turbine is stationary and at the highest temperature which the bearings may be expected to reach; for if the oil has not sufficient body to resist the pressure when the machine is at rest, there will be metallic contact between the shaft and bearings, and abrasion will occur on starting. Further, although the oil gets round the bearings after a few revolutions, the damage will already have been done.

Viscosity of Lubricant.

The more viscous a lubricant, and the stronger the adhesion between it and the bearings, the greater the pressure it will sustain, but a too viscous oil creates unnecessary friction, and power is wasted in overcoming it. The viscosity of the oil, at 140 degs. to 150 degs. F., should therefore be sufficiently high to keep the journals and bearings apart when the machine is at rest, combined with good adhesive properties on account of the high velocity of the shaft when running. To obtain the highest lubricating efficiency, it is essential that the oil should not contain or absorb moisture, as owing to leakage of steam condensation, water is bound to come in contact with the oil, which in some cases emulsifies, and this again has the effect of simultaneously increasing the co-efficient of friction and decreasing the efficiency of the lubricant, which more or less rapidly becomes a soap. The careful selection of the crude oil from which the lubricant is prepared is therefore of the utmost importance.

It is also possible for a refined oil to be almost absolutely free from saponifiable products and yet to gradually generate these at high temperatures when under the influence of ordinary atmospheric conditions. Such an oil is unsuitable for turbine lubrication, as the used oil is generally filtered for use again, a process which cannot be satisfactorily accomplished with oils of this class. It has also been observed in some cases that oil used in a turbine slowly darkens, some oils quicker than others, and this is an indication that the oil is undergoing chemical changes due to oxidisation, and so becoming useless for its purpose. In time solid particles will be deposited by such an oil, and these will probably contain a fair percentage of saponifiable matter, although the oil previous to the change contained only a minute proportion of such matter. These deposits may be caused by the evaporation of the lighter elements in the oil, or, in some rare instances, by electrical decomposition. To avoid this the oil should have a fairly high boiling point, and not be made up of a blend of oils having different evaporation points.

During the course of an interesting series of tests recently made with Sternol White Russian non-emulsifying turbine oil on a 1,250 k.w. turbo-generator for the Harrogate Electricity Works, close attention was paid to the behavior of the lubricant, which was shown to be a very highly refined product entirely free from acid and other impurities and absolutely dry. Being thus non-oxidising, the Sternol oil will maintain efficient lubrication in turbine bearings for a practically indefinite length of time, and that to even as low a temperature as 20 degs. F. With a flash-point, open Marcussen test, of 335 degs. F., the loss by evaporation does not exceed 0.4 per cent. after heating for five hours to a temperature of 212 degs. F. No sign of gritting or corrosion was observable after the conclusion of the tests, which were carried out under the following conditions:—Mean r.p.m., 3,000; steam pressure, 156 lbs.; superheat, 456 degs. F.; oil pressure, 40-50 lbs.

A no-load run of 4½ hours gave a mean temperature rise on the five bearings of only 4.2 degs. F., while a three hours' run, with a load varying from 625 k.w. to 1,250 k.w., showed a mean increase of temperature on the five bearings of 12.8 degs. F., the temperature of the inlet oil going up from 102 degs. F.; to 118 degs. F. during the three hours, due to an insufficient supply of cooling water.

GAS AND OIL ENGINE PROGRESS

A Record of Principles of Design, Construction and Achievement in a Rapidly Developing Sphere of Power Generation.

DEVELOPMENT OF GAS TURBINES.

GAS turbines may be classified in three categories, viz.—hot-air turbines (derived from hot-air engines); hot-air and steam turbines (derived from gas engines), and explosion turbines (derived from gas engines), says a writer in The Power User. In the course of a long serial article in Die Turbine, the theory of each of these types is developed, and the author concludes that practical development in this class of prime mover will be confined to the hot-air and steam turbine, and the explosion turbine.

A comparison with other thermal engines requires for favorable results, 70 per cent. efficiency on the rotary pump, and 75 per cent. thermal efficiency in the turbine. The advantages of the hot-air turbine include small fuel consumption, no boiler, operation at low pressure, small space occupied, low maintenance costs, uniform torque, and absence of reciprocating parts. The disadvantages are the necessity for a rotary compressor of low efficiency, attack on the blades by dust carried through from the gas generator, production of sulphurous gas in the regenerator, high temperature reached in the turbines blades, and finally, the difficulty of regulation.

The explosion turbine possesses, with the exception of the small fuel consumption and even torque of the hot-air and steam turbine, all the advantages of the latter. The compressor is smaller and regulation more convenient. since it can be obtained by displacing the nozzle. On the other hand, efficiency is low, the pressure on the blades varies periodically and there occurs a great loss of heat by radiation from the explosion chamber. The danger of production of sulphurous gas in the regenerator no longer exists, and there are reasonable grounds for believing that the gas turbine may soon be used successfully in fuel-oil districts. The establishment of central stations containing generators driven by gas turbines offers great possibilities. The hot-air and steam turbine appears to be best adapted to this service, despite its high cost of installation, which is compensated by the fuel economy and security of operation. The gas turbine is easily adapted to the use of coke oven or blast-furnace gas, but the space occupied by the hot-air and steam turbine is then so great that the explosion turbine is preferable, although it is less economical. The only explosion turbine at present capable of industrial use is the Holzwarth machine.

There is a possibility that the explosion turbine will obtain considerable importance in automobile and aeroplane practice, where the advantages of a rotary engine compensate for increased fuel consumption.

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LIGNITE IN SASKATCHEWAN.

THE plant which is now being erected at Estevan by the Saskatchewan Government for the purpose of testing the lignite coal of that district has been placed in charge of S. M. Darling, who has had experience of the work in North Dakota.

In this connection it is to be noted that the current issue of the Public Service Monthly, published by the Saskatchewan Government, contains a full report of the results obtained from the lignite of North Dakota, which is of the same character as the lignite of South Saskatchewan. The chemical composition of this lignite does not allow of its being successfully briquetted in its natural condition. To market the lignite commercially on a large scale, it must be destructively distilled, carbonized, or partially carbonized, and the resulting gas, oil, or tar, ammoniacal liquor and carbon residue, utilized separately.

By carbonization of the North Dakota lignite, the products, in round numbers, are:—gas, per ton of lignite, 10,000 cubic feet; oil or tar, 20 gallons; ammoniacal liquor, 35 gallons, and carbon residue, 1,200 pounds. The gas is of high heating value, and while containing a good percentage of illuminant, has about 15 per cent. of carbon dioxide, which almost entirely destroys the illuminating power. The carbon dioxide can be removed by passing the gas through lime, but the process is too expensive for commercial application. The gas can be used as an illuminant by mantle; but it is for fuel and power that its main available serviceableness can be made useful. The oil yields, on distillation, various light oils, benzine, etc., 36 per cent. of creosote oils and 22 per cent. of hard pitch, while the ammoniacal liquor yields several products for which there is a growing market, particularly in the case of sulphate of ammonia, as a fertilizer. The carbon residue, 1,200 pounds to the ton of lignite, can be briquetted, using 6 per cent. of the lignite pitch as binder. The briquettes burn with a short flame, no odor, no smoke and no clinker, and they can be used wherever anthracite or bituminous coal is burned. They retain their structure in the fire until completely burned, and do not disintegrate or lose value under the weather; they can therefore be shipped considerable distances without loss. The lignite coke is described as an ideal gas producer fuel, effecting a great saving over the present method of producing electricity by means of boilers and steam engines.

It is now an accepted fact among engineers that hydro-electric development in Saskatchewan is an impossibility. The rivers to the north carry so much silt and mud that the working parts of any turbine yet devised would be cut to pieces before the machinery could begin to pay for itself. The question of a large central power plant at the Estevan mines to generate electricity for transmission over a wide area is essentially one of the quantity of current that can be sold, the distance it must be transmitted, and evenness of load. If the current needs be transmitted a long distance to a large centre of population, there must be intermediate towns in which substantial quantities can be sold. It is simply a question of population. Of course, with cheap power, the population will come. Meanwhile, the immediate demand is for solid fuel.

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B. B. Kelliher, chief engineer of the G. T. R. has sent in his resignation on account of ill-health. Mr. Kelliher has been engaged for fifty years on railway construction.

REFRIGERATION DEPARTMENT

CENTRAL STATION SERVICE FOR ARTIFICIAL ICE PLANTS.

By W. J. Moore.*

UNTIL recent years most artificial ice plants were driven by steam engines, and the ice was manufactured from the distilled water obtained by condensing the steam exhausted from the engines. In order to entirely remove the cylinder oil from the water supplied in this manner, and thus prevent it from becoming frozen into the ice, a complicated filtration system was necessary.

A marked improvement in the process of ice making was later introduced, namely, the adoption of the multiple-effect evaporator. This machine operates on the principle that less heat is required to evaporate water under vacuum than under atmospheric pressure. By the use of this apparatus there may be obtained an evaporation as high as 50 lb. of water per lb. of coal, while distilled water can be secured at low cost and free from oil. It therefore became convenient to drive the main compressors by a compound condensing engine, an oil engine, a gas engine, or any other type of prime mover which could be operated economically and which would give continuity of service.

Due to the general realization by central stations that the ice plant was desirable from the standpoint of constant load and high load-factor, and in keeping with the practice of making reductions in rates for the class of users taking current at off-peak periods, power companies have been in a position to make attractive inducements to artificial ice plants.

Raw Water Ice.

Various methods have been devised for making ice without the use of distilled water, where local conditions are favorable for obtaining satisfactory well, spring, or city water. The original raw water system, adopted for the manufacture of ice direct from well, spring, or city water, was known as the plate system, and consisted of freezing water into large cakes sometimes 9 ft. by 16 ft. by 12 in. in size and weighing five tons. In this system cold brine is made to circulate through hollow plates immersed vertically in tanks filled with water. The water is agitated and the ice forming on both sides of the plates rids itself of any air or impurities. The large cake thus formed is removed by a crane to a sawing table and there cut into cakes of the desired size.

Within the last two years considerable progress has been made in perfecting the raw water can system. This system necessitates a modification of the can, as used in the manufacture of distilled-water ice, because the water must be constantly agitated during the process of freezing. An air pipe is connected at the bottom of the can, through which air is supplied at about 3 lb. pressure. Water in freezing liberates its entrained air and carbon dioxide, which are carried off by agitating the water. If, for any reason the agitation ceases, the bubbles of air and carbon dioxide are frozen into the block, which causes the ice to be opaque. The quantity of air required for agitation depends upon the rate of freezing and varies with different waters.

In the process of freezing small crystals of pure ice are formed. As the crystals form, the soluble mineral salts, being more capable of solution in water than of being frozen into ice, are removed by the water which has not as yet become frozen. If the proper agitation takes place, solids and matter in solution or in susupension are pushed ahead of the freezing ice until they arrive at the center of the can.

Removing the Can Core Water.

When about 12 to 40 lbs. of water are left still uncongealed in the center of a 300-lb. cake (the amount depending upon the type of freezing system used) this water, which contains practically all of the impurities originally in the 300 lbs. of water, is then removed. Various methods have been adopted for removing this core. One method provides for its removal by opening a master valve controlling a drain pipe, which drains out the impure water from 60 or more cans by one operation. Another method is to withdraw the water from the top of each individual can by means of a suction pump. The hole through the center of the cake is then filled with distilled water, or additional raw water, and the cake frozen solid. Ice manufactured by the raw-water system is more sanitary, palatable, and more nearly free from odor than that made by any other system. The cake is transparent and has a slight feathery appearance at the center. Recent tests have shown that while the impure core-water may contain 200,000 bacteria per cubic centimeter, the entire cake will contain on the average less than 20 bacteria per cubic centimeter after the core-water has been withdrawn, fresh water added, and the cake completely frozen.

Previous to the adoption of the raw-water system, central stations did not consider the artificial ice business as within their field of operations. They regarded the production of the necessary amount of the engine exhaust a serious handicap to economical manufacture by electricity. However, with the advent of this system, central stations could compete in power costs with the gas producer, oil engine, and high-economy compound condensing engine; and their attention was therefore directed to the large possibilities presented by this class of business.

Much has been acomplished within a short time in this new field. The city of Chicago has fifteen central-station-driven ice plants (the daily tonnage ranging from 60 to 140 tons each, totaling 1,355 tons with an aggregate installation of 5,344 h.p.); Buffalo, N.Y., has five, operated by Niagara Falls power; and there has recently been built in Brooklyn, N.Y., two of the largest electrically-driven raw-water ice plants in the world, which are operated entirely by central-station power.

First Cost of Central Station Operated Plant.

The first cost of a central-station-operated plant is considerably less than that of an engine-operated plant with a consequent reduction in fixed charges, such as interest, depreciation, insurance and taxes. The space required for an electrically-driven plant is less than for a steam plant. The plant operated by electricity may be located in residential sections, where, due to the nuisance of smoke, noise, etc., steam plants would not be allowed. Hence, having a central location with respect to customers, delivery charges and shrinkage are reduced to a minimum and prompt deliveries are assured.

The use of the electric motor meets with favor by the ice manufacturer, since it eliminates engine and boiler

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Small Motor Department, General Electric Co., New York Office.*

troubles; the necessity for making boiler repairs having recently shut down a large plant in Brooklyn for five days during the hottest weather.

Artificial Ice Superior.

The artificial ice plant makes the ice man independent of weather and furnishes a grade of ice that is superior to natural ice, for it is purer, cleaner, more transparent, and more uniform in size, purity, and density. The use of natural ice is rapidly decreasing. A number of the Great Lake cities no longer use it, because the streams from which it was taken have become impure due to the increase in population, sewage, and polluting refuse from manufacturing plants, etc. No more natural ice is being shipped up the Potomac River, and a large electrically-driven raw-water plant has been installed at Winnipeg, Canada, where the temperature in the winter is often 40 deg. below zero, and in Minneapolis, Minn., where from zero to 20 deg. below is often prevalent. The city of Buffalo, N.Y., will soon be entirely supplied by artificial ice.

Natural ice can be cut for about 15 cents per ton, but added to this is the cost of shrinkage, storage, loading on cars or boats, transportation, dock rentals, etc. These factors, together with the long hauls from the railroad terminals or docks in the cities, make the final price only slightly less than that of the artificial product. The quality of the artificial product enables the manufacturer to over-balance any difference in price and compete with the natural ice dealer.

Power Cost.

In the manufacture of the average article the power cost may be between 2 and 5 per cent., while in ice making it ranges between 30 and 50 per cent. of the total cost of production. It is apparent, therefore, that the cost of power largely affects the cost at which ice may be manufactured. The power required to manufacture one ton of ice would of course depend upon the system used, and the type and efficiency of the machinery. Data are available which show that in a raw-water plant of about 100 tons capacity, it may take as low as 45 kw-hr. or as high as 60 kw.-hr. per ton of ice. The average throughout the country is about 52 kw.-hr. per ton of ice produced, based on cooling water at 65 to 70 deg. F., the exact figures depending upon the conditions existing at the plant.

Ice Plant a Desirable Central Station Load.

From the central station standpoint, the ice plant is a very desirable load. Current is used 24 hours a day, and the peak of the ice plant does not overlap the peak of the central station. The maximum peak of the average central station occurs during the months of November, December, January and February, and between the hours of 4 and 8 p.m. During this time, the main compressor motors of the ice plant may, without any inconvenience, be shut down and the small auxiliaries operated without interfering with the production of ice. As a result, the central station can consistently offer a low rate for current.

In order to insure continuity of operation and to be in a position to offer a low rate, the central stations may furnish current from their primary system, that is, direct from the main generators, and thus eliminate transformer losses. At Buffalo, high-tension power at 2,200 volts is delivered to the compressor motors; in Brooklyn, the primary current direct from the main generating station is delivered at 25 cycles and 6,600 volts to the ice plant, where it is transformed to 440 volts for use at the motors.

Reliability of Service.

From an engineering standpoint the ice plant presents a serious problem to the central station as regards reliability of service, for considerable trouble in the ice plant might develop due to momentary shut-downs; more so than ordinarily results from the shutting down of the usual industrial plant. Great care must be taken to prevent momentary interruptions to the service, for when the large compressor motors are shut down it interferes with the ammonia distribution, and, as the ammonia compressors must start under full load, a return of current on the line is very apt to blow the fuses and otherwise interfere with the operation of the plant. It has been found necessary to devise a system of no-voltage relays in order to eliminate possible fuse trouble with its attendant delays.

Question of Transformers.

The question of transformers for use in connection with ice plants is a very important one. Manufacturers of transformers frequently design them bearing in mind that in ordinary use they will have a chance to cool due to variations in load. The ice-plant load is practically constant, and this should be kept in mind in selecting the size of transformers to be used. Where different makes of transformers would operate in parallel in an ordinary industrial installation, such operation in ice plants often results in the burning of either one or the other make. This is due, of course, to unequal distribution of the load caused by the difference in impedance of the transformers.

The Lighting Feature.

It is advisable that the lighting system of the ice plant should have available a source of power other than that furnished by the power circuit, from which the motors are operated so that, in case of an interruption to the power supply, the lights can be supplied from this separate course. It is considered good practice, also, to independently connect the motors operating the compressors that furnish the agitating air so that they, too, may have a separate power circuit available. Interruption of the flow of agitating air causes white streaks in the ice.

Type of Motor.

With reference to the type of motor to be used in driving the main compressors, where alternating current is supplied, it is advisable to use the wound-rotor type. The resistance should be designed for starting duty only, as it is the general practice in ice making to use constant speed. It is also desirable to use that type which provides for the lifting of the brushes from the collector rings and also for short circuiting them. This device increases the efficiency of the motor, inasmuch as it eliminates from the secondary circuit the resistance of the brushes and the leads to the controller. When it is considered that the ice plant operates 24 hours a day for months at a time, it will be realized that a difference in efficiency of 3 to 5 per cent. in the main compressor motors is a matter of importance. Up to 150 h.p. it is well to use induction motors having the internal-resistance type of phase-wound rotor. These motors have met with marked success in this field of application.—G. E. Review.

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MISCELLANEOUS QUERIES.

Question.—Is the absorption ammonia system of refrigeration as liable to serious accidents due to escaping gas as the compression system?

Answer.—It is more liable. The necessary length of piping in the absorption system is much greater than that required by the compression system; for this reason the liability to such accidents as result from leaking and broken pipes is greater.

* * *

Question.—Is compressed air to be recommended for cleaning boiler tubes?

Answer.—With steam of very high pressure or with superheated steam (the latter tending to the rapid deterioration of the hose), there is considerably more risk to the operator should hose fracture take place. On the other hand, compressed air has the disadvantage that it strikes the tubes at a much lower temperature than that of steam, a contingency, of course, hardly desirable.

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"IF I HAD MY WAY."

THE title of this editorial is intensely human, because of its universality, and because of the expressed sentiment being more or less personal to all of us. We have each wished to have things planned, ordered and carried out in accordance with our views and opinions, on occasion, forgetting meanwhile, if not altogether regardless of the effects on others, that our way in its individual essence would lead only to a dead end. In the spheres of politics, sociology, business and finance, the spirit of our title is everywhere rampant, and its practice is in part effected wherever possible, and would further if dare be. In a word, autocracy is a leading constituent of our mental fabric. Wilful Willie willed to have his way, but as many less prominent people have found, it has been determined otherwise, hence the all-European War.

We reckon, and judging from appearances that in the present instance are in no way deceptive, there has been a particularly strong inclination on the part of Canadian manufacturers to exercise what seemed to them a prerogative, to wit, to take no chances while the war lasts, or for the period, however indefinite, that surpluses were unlikely to materialize. In the case of employees too, there has been at this time a pronounced tendency in many cases towards resisting the installation of shorter hours of labor or of a remodelled remuneration system whereby not only more hands would find work, but there would be retained to and maintained for any particular enterprise or organization its personnel in expert efficiency.

In desiring our own way, we are consciously or unconsciously looking out for our little individual selves, and among the many lessons that are being and will yet be taught us by the relative effects of this European War in which we are involved is that, whether we be employer or employee, self-seeking or self-assertion at the expense of another or others—having our way, must be banished in every form and particular.

◆

EFFICIENCY ENGINEERING IN THE POWER PLANT.

THE popularity of the **efficiency engineer** is due to the fact that he has succeeded in proving to quite a number of men in competitive business that he can, by judicious planning, produce manufactured goods at less cost than hitherto obtainable. At the present time when, on account of the financial depression, many plants are kept running at scarcely a profit, the man who can devise practical savings is brought to the front. Heretofore, in the manufacturing world, if the article could be turned out in first class condition and in sufficient quantities, the plant was regarded as successful. To-day, however, these considerations give us little concern, for a manufacturer, to succeed against his opponents, must produce the goods cheaper with the same appliances.

Similar conditions are asserting themselves in the power plant, and the engineers and firemen who grasp the present opportunity by producing and presenting savings in expense to the employer when the latter is interested, will assuredly reap their reward. The man who is satisfied to keep his engines going with as little trouble as possible in order that he may have the more time to sit in a chair tilted at an angle of 45 degrees to the wall is, one of these days, going to have his solitude disturbed by the efficiency engineer who will get not only the credit for what the engineer ought to have done, but a much higher remuneration than the latter would have asked.

The field for possible improvement is vast. It is said that, of the 200,000,000 tons of coal used yearly in the power plants of the United States and Canada, 55 per cent. of the heat value is wasted. Previous to the manufacturer being shown what could be accomplished in the factory end of his business, he would hardly have credited the above statement, but now he is ready to believe most any assertion in connection with possible economy, so that the duty demanded of the engineer in the immediate future will not be to keep the engines and lights going and the building warm, but to produce these commodities at a lower cost.

THE OPERATORS' VIEWPOINT

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

CORRECTING DEFECTS IN A HEATING PLANT.

By H. W. Benton.

THIS article is supplemental to that which appeared on pages 249 and 250 of our August issue and as the title implies, it deals with the rectification of a badly laid out heating system. In addition, a brief summary of results achieved in the plant as a result of the detailed steps taken is also appended.

Treatment of Heating System.

The heating system defects were poor piping arrangement of the supply main, and practically no drainage of the radiators. The pipe lines were altered so as to ensure a good supply and traps were fitted to each radiator drip line, all traps discharging into a vacuum return line. The vacuum pump discharged into an overhead tank from whence the water was taken by boiler feed pump and delivered back again to the boilers. The boiler feed water was cleared of grease by a grease extractor and filter in the feed line to boilers.

An attempt had been originally made to supply exhaust steam to 11,000 feet of one-inch pipe, for direct radiation wall coils through a three-inch line 312 feet long. This line was connected to and supplied from the six-inch exhaust main by a 2½-inch line having four 90-degree and three 45-degree elbows. Then again, at the radiator end of the three-inch line, the connections were bad. It had been figured that, as the varnish room was on the third floor, and must be kept hot no matter the cost, it would be wise to pipe the steam first to this floor as shown by Fig. 1.

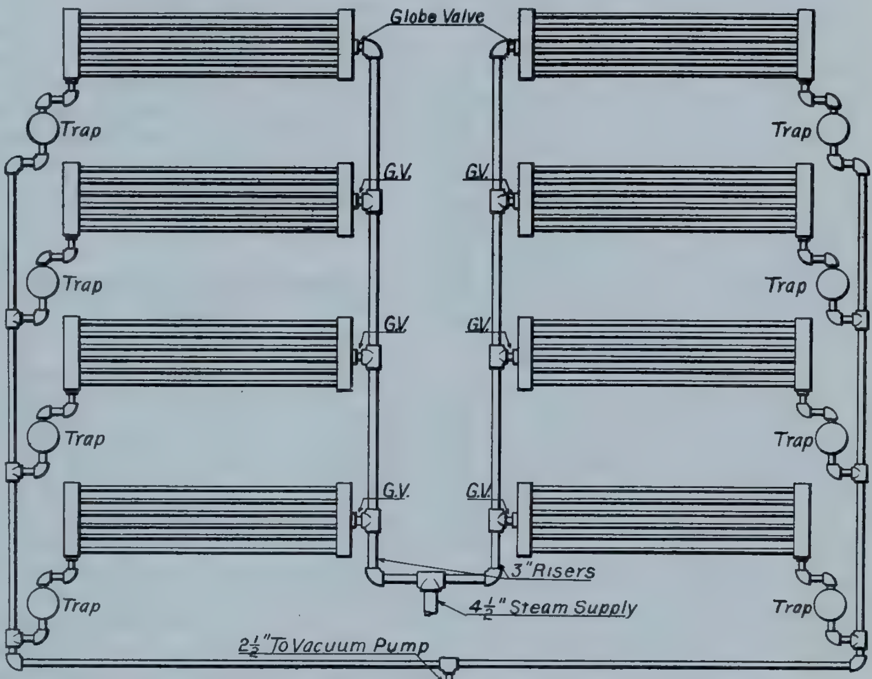


FIG. 2—DIAGRAM SHOWING REARRANGED PIPING WHICH HAS BEEN A SUCCESS.

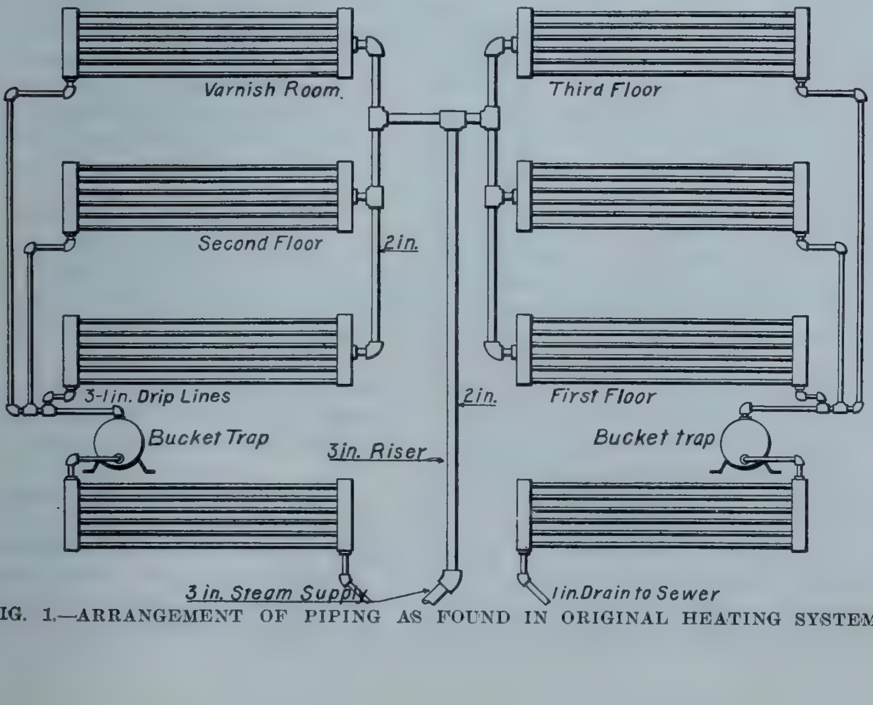


FIG. 1.—ARRANGEMENT OF PIPING AS FOUND IN ORIGINAL HEATING SYSTEM.

The six wall-coil radiators, two on each of the three floors, were piped into two bucket traps, three into each. The traps discharged into the basement wall-coils, the idea being to keep the chill off the basement by using the hot water discharged from the six steam-supplied radiators. Thus the basement was heated by hot water, and these two basement radiators were each drained by a one-inch line into the sewer. The 11,000 feet of one-inch pipe was laid-out to be supplied with steam by a 2½-inch connection; and all condensation was carried away by two one-inch pipes. No wonder the system would not work.

A 4½-inch steam main was fitted in place of the 2½ and 3-inch pipes and all unnecessary ells and bends eliminated. See Fig 2. This, together with the installation of the necessary traps and the vacuum return line, completely cured the heating system, which worked perfectly with 2½ pounds pressure per square inch on the exhaust main and ten inches vacuum on the vacuum return line. Each and every piece of pipe in the building was too hot to bear the hand on, and the whole system was practically noiseless in operation.

Results To Power Plant.

The Stirling boiler could supply all the steam required for all purposes, and did it easily, and the Bates Corliss was equal to all the load possible. With lots of steam and lots of power and everybody happy, the factory once more swung along at a steady good-natured pace, and the refuse piled up in the boiler house so that the attendant had it for fuel for hours during the night shift.

No daily coal account was kept, but the coal report for the previous year before repairs gave a monthly average of 183 tons. The average after repairs and alterations was 55 tons per month. Instead of wasting all the exhaust steam and using live steam for heating, the heating now took all the exhaust steam, by simply making the system suitable for the work. In the summer, the dry kiln used about three-fourths of all exhaust steam and in winter we made up the shortage of exhaust steam by using live steam reduced to 2½ lbs. pressure through a Davis pressure-reducing valve piped up to deliver low pressure steam into the exhaust main.

Before the plant was overhauled, both stacks smoked jet black most of the time, and there was enough steam going out of the exhaust head to do credit to a 400-horse-power outfit. After the changes were complete, the manager said: "Well, if anyone had told me beforehand what an improvement could be made in this plant with so little fuss and delay, I would have passed it up as so much hot air, but I must admit the results are here, and while a few months ago our plant was all exhaust steam and jet black smoke, now there is no smoke and almost no exhaust wasted."

In conclusion, nothing smart had been done. We had simply located the defects and had eliminated them by proper methods. Similar and, in some cases, greater savings can be made in nine plants out of ten right here in the Province of Ontario.

WANTED A DISTINCTIVE TITLE.

By J. P. S.

A GREAT deal has been said and written of late concerning the requirements of an engineer. In the United States and very largely in this country the man who builds the engine is called a machinist, and he who operates the throttle is spoken of as the engineer. In Great Britain and other parts of the Empire the builder is the engineer and the operator is the engine-driver.

There seems to be little objection in America to a man calling himself whatever he likes, and for this reason most of the professional cognomens have lost a large part of their original significance, and, as a consequence, no longer give the bearer of it the social status that it once did.

A very sensible application of the word is found in marine practice. Here the man in charge of all mechanical appliances of a ship is known as the chief engineer, and his subordinates are known as assistant engineers.

There is nothing to prevent this system being adopted also in power plants. The man in charge of large mercantile buildings or factories who supervises everything in the line of heating, plumbing, sanitation and power has nothing in the way of a calling that will place him in any way above his subordinates.

WRITING FOR THE TECHNICAL PRESS.

By J. E. T.

MANY engineers are perfectly willing to tell others verbally about different troubles they have had in power plant operation, and how they got over them, but mighty few will take hold of a pen and draft out the details in the shape of a story for publication in the columns of engineering journals devoted to their particular calling. They are apparently afraid they will get laughed at, and seem to think that unless the article is grammatically correct, etc., the editor will turn it down, or perhaps print it under the writer's name with all the mistakes showing.

I know whereof I speak, because it was years before I could screw up courage to send in my first story. This was printed altogether different from my crude composition, for in all cases the editor had straightened out any little mistakes, and also polished up the style, so that the readers never knew but that the author was a real top notcher at story writing. Since my first attempt, I have written several hundred articles for six different papers, receiving from one to twelve dollars per contribution, also winning two first prizes from Popular Mechanics of ten dollars each for the best original article in a given month, besides receiving the regular pay for the contributions. All this pocket money has come to me from the start I made with my little 200-word letter to an engineers' monthly journal ten years ago.

Engineers have told me about some kink they used, and when I have advised them to write it up and send it in for publication they would laugh at me and tell me to do it myself. You can gamble on it that I always did so. In several cases the ideas I have heard about and described in one journal have been copied by other papers in both the United States and Canada.

Almost every engineer could tell of some good thing worth knowing, and, although it may appear too simple to him to be good enough for publication, it is just such little simple kinks that lots of lifetime engineers fail to learn. Things that are in text-books or other journals are not wanted, of course, but the simple or difficult schemes worked out by yourself or some friend are the ones most appreciated. You will perhaps be helping some engineer out of a bad hole by telling about it, and the dollar or two which you will get from the publishers will doubtless come in handy. After the first effort, things will be easy, and seeing your writing in print will give you confidence and a better opinion of your own worth, and by appreciating yourself and your work more, the better man you will become. Try and see how easy it is.

TANK CONTENTS QUERY.

EDITOR The Power House.—Will you solve through your journal the following problem:—A horizontal cylindrical tank, 8 ft. in diameter and 23 ft. long, is filled to a depth of 26 inches with oil. How would you determine the quantity of the latter —H. Sorensen, Montreal.

Answer.—Find the area of the end of the body of oil and multiply by its length. The end is in the form of a segment of a circle, and the easiest way to find its area is to find the area of a sector of the same angle and subtract the area of the triangular part.

(1)—To find the chord or the width of the oil surface:—From the diameter of the tank subtract the depth of oil; multiply the remainder by four times the depth, and extract the square root of the product. Diameter = 96 ins.; depth of oil=26 ins., and difference=70 ins.

$$4 \times 26 = 104, \text{ and}$$

$$\sqrt{70 \times 104} = \sqrt{7280} = 85.32 \text{ in.}$$

(2)—To find the angle of the sector:—We have a right angled triangle with all three sides known. The hypotenuse is the radius of the circle, which is 48 ins.; the base is 85.32÷2=42.66 ins., and the other side is 48—26=22 ins. The angle between the hypotenuse and the vertical side is half the angle of the sector.

$$\frac{42.66}{48} = .88875,$$ which is the sine of the required angle. From a table of sines we find this to be the sine of an angle of 62.64 degrees. The whole angle of the sector is then, 62,64×2=125.28 degrees.

(3)—To find area of sector:—Area of circle=$48^2\times3.1416$=7238.246 sq. in.

Sector of 360 degrees has an area of 7238.246 sq. in., and sector of 125.28 degrees, therefore, has an area of

$$\frac{7238.246\times125.28}{360}=2518.91 \text{ sq. in.}$$

(4)—To find area of segment:—Area of triangle $=\dfrac{85.32\times22}{2}=938.52$ sq. in.

Area of segment = area of sector minus area of triangle = 2518.91—938.52=1580.39 sq. in.

(5)—To find volume of oil:—Multiply area of cross-section by length, or

1580.39×23×12 cubic inches.

1 Imperial gallon=277.274 cubic ins.

$$\text{Number of gallons}=\frac{1580.39\times23\times12}{277.274}=1573.12 \text{ gallons.}$$

The answer in cubic feet would be

$$\frac{1580.39\times23\times12}{12\times12\times12}=252.42 \text{ cu. ft.}$$—M. L. S.

WHAT SUPERHEATED STEAM IS ACHIEVING

A REDUCTION in water consumption of approximately 1,000,000 gallons per engine per annum has been achieved on such locomotives upon the London and North-Western Railway as are fitted with superheaters, according to Mr. Hewitt Beames, of the engineering department at Crewe. They indicate merely one of the advantages offered to a railway company by the use of steam that is heated far beyond the temperatures obtainable in boilers under old-time conditions. Economies of equal importance are to be obtained by superheating in nearly all power plants, portable or stationary.

Superheat in Theory.

The mechanical equivalent of the British thermal unit is 778 foot pounds; the heat which is developed by the combustion of 1 lb. of ordinary good coal amounts to about 15,000 units, and of this about 75 per cent. is as much as can practically be extracted in a steam boiler from the products of combustion. The other 25 per cent. passes away in the chimney gases at too low a temperature to be of any practical use for steam raising, leaving the available heat from a pound of coal at 11,250 units. The heat remaining in the products of combustion is also necessary for creating sufficient chimney draught.

In dealing with water as a medium for converting heat to motive power the temperature has first to be raised from that at which it is pumped into the boiler to the boiling point at the pressure at which steam is to be used; this being through about 250 deg. F. ordinarily, which would be equal to 250 units per lb. of water, and it would further require about another 870 units for converting it to saturated steam, a condition in which that would contain as much water as it would hold, so to speak at the temperature and pressure. The figures are simply argumentative. Roughly, it is evident that every pound of steam used in the saturated condition would require about 1,120 units of heat for its formation, and that 1 lb. of coal would evaporate about 10 lbs. of water at the pressure.

Condensation Losses.

Saturated vapor such as this parts with its heat very readily by reason of its high heat-conducting power, and when it enters an engine cylinder, the metal of which in working is always cooler than the steam used, it loses heat to the cylinder walls (as the bore and passages are termed) to an extent which reduces about 20 per cent. of its volume to water, which portion is consequently inoperative for propelling the piston and so producing power. As the steam expands in the cylinders, part of this collapsed steam re-evaporates by reason of the reduction of pressure, but most of the heat which is taken up by the walls on entering passes away with the exhaust steam. This is roughly the action of saturated steam in an engine, and in the final result from compound engines the efficiency or proportion of the heat which is converted into work is about 13 per cent. of that which the boiler takes up from the products of combustion.

The main reason for this low efficiency is that a large portion of the original heat of the steam passes away with it at a low temperature and pressure after it has worked in the cylinders, the lower pressure of the exhaust containing nearly as much heat as the higher pressure by reason of the quantity required for evaporation at a low pressure being nearly the same as at the higher, pound for pound.

Heat Conducting Power of a Dry Gas.

Now the heat-conduchting power of a dry gas, that is, such as contains much more heat than is necessary to maintain it in a gaseous condition, is almost nothing as compared with that of a wet vapor such as saturated steam. When steam is heated to a higher temperature than that for the same pressure of saturated steam it has the properties of a dry gas as regards conduction of heat, and in working in engine cylinders does not collapse after the manner of saturated steam as explained; nor does it lose its heat to the walls to any appreciable extent. Its action, therefore, is simple and direct, with none of the heat complications of saturated steam. Moreover, the superheating of steam increases its volume, so that a less weight of water exists in any given charge which is given to a cylinder, and the original heat of vaporisation is consequently less per volume than with saturated steam.

These differences between the nature of steam in a saturated condition and as a dry gas so affect the final result of the working of a steam engine as a heat engine with the latter that its efficiency is raised to about 22 per cent. of the 75 per cent. of the heat of the fuel which is taken, as explained, from the products of combustion.

Following these effects a little further, it has been seen that the total expenditure of heat per pound of saturated steam would, on the supposition, be 1,120 units, and the work obtained at 13 per cent. would be the equivalent of 145.6 units. What should be the result if the same quantity of heat be put into 80 per cent. of the water of saturated steam? That is, if the 80 per cent. which does not collapse (as saturated steam) on entering an engine is heated up by the heat contained in the 20 per cent. which does collapse, what would the result be in work? Or, more properly, what would the work capacity then be?

Temperature Limits.

As saturated steam, the 80 per cent. would contain the equivalent of 896 units per volume, and the rest of the 1,120, or 224 units, would be available for increasing the volume and further work over the 13 per cent. efficiency mentioned. The increase of volume from about 3 to 4 would absorb about 30 units, leaving 194 units to add to the 145.6 for work. This is more than double, but the temperature of the steam would be impracticably high if superheat was carried out to this extent, as it would be in the region of 800 deg. F. About 650 deg. F. is a practicable temperature, while 600 deg. F. would be well on the right side. Taking the latter, the increase of temperature over 350 deg. F. for saturated steam would be 250 deg. F., and this at a specific heat for superheated steam of .55 would be 137.5 units per pound. Deducting 30 units for increase of volume as before mentioned, 107.5 units available for work would be added to the 145.6 units (at 13 per cent.). This brings up the work-heat to 253.1 units out of an expenditure of 1,120, which is 22.6 per cent. efficiency, a point which is reached in everyday work.

The steam engine worked by superheated steam is thus as efficient as a heat-work converter as the ordinary internal combustion engine, and as a prime mover which is absolutely controllable in any circumstances or conditions it is generally recognized to be vastly superior to any other heat engine.

Instruction Course for Power Plant Operators---V.

By M. L. Smith, B.A.Sc.

Throughout the writer's experience as a teacher, he has been continually confronted with the query: "Can you recommend a text book for power plant employees?" This, on account of specialization of the different branches of the work and the fact that most books published deal with methods of particular localities, is practically impossible. This series of articles is intended to supply the need, to set forth the technical points so that firemen and engineers can understand and apply them, and be thereby assisted in passing the various qualifying examinations.

CLEARANCE VOLUME.

THE cubic space between the valve face and the piston head with engine on the dead center that must be filled with steam before any work can be done on the piston is called the **clearance** volume. It can be easily measured in a horizontal engine, and with a little care, in a vertical engine, in the following way:—Place the valve so as to cover the port completely; or if this cannot be done, remove the valve and clamp a piece of sheet packing over the port with a smooth flat piece of wood. Next set the engine on the dead center and, by removing the indicator cocks, fill the clearance with water. This can be measured and its volume calculated. The clearance in volume is usually given as a per cent. of the stroke volume. If the clearance is given as 5 per cent., it means that the clearance volume is 5 per cent. of the stroke volume or the cubic space swept out by the piston at each stroke.

As the clearance volume must be filled with live steam at every stroke, and up to the time of cut-off this steam does no work whatever, it represents a considerable loss. After the point of cut-off it expands with the rest of the steam and does work. To make the clearance as small as possible, the ports are made narrow and short and the piston head is made to come as close to the cylinder head as practicable to avoid knocking. In slow speed releasing gear engines the clearance will run from 2 to 3 per cent. and in high speed engines from 8 to 12 per cent. The word clearance is also used in another sense, such as **piston clearance, valve clearance, cross head clearance,** etc. By piston clearance is meant the distance between the piston head and the cylinder head when the engine is on dead center. This may be from 1/8 to 1/4 inch, or even more.

Cut Off.

Cut off is usually spoken of as a percentage of the stroke; thus, if the cut off is said to be at 50 per cent., it means that the steam is shut off when the piston reaches the middle point of its stroke. It is also often mentioned as being at 1/4, 1/2, 3/4 stroke, etc., which, of course, explain themselves.

In calculating **mean effective pressure, number of expansions,** etc., it is necessary to take account of two distinct kinds of cut off; namely, **real** and **apparent.** Real cut off is the ratio of the volume of the steam in clearance and cylinder at the point of cut off to the volume of steam in clearance and cylinder at the end of the stroke. **Example:**—If the clearance volume be 200 cubic inches, cylinder volume be 1,200 cubic inches and the engine cut off at half stroke, the point of real cut off is $\frac{600—200}{1200—200} = \frac{800}{1400} = \frac{4}{7}$ or 57.1 per cent.

Apparent cut off is the ratio of the length of stroke at the point of cut off to the length of the completed stroke. **Example:**—If an engine having a stroke of 32 inches cut off at a point 20 inches from the starting position, the apparent cut off will be at $\frac{20}{32}$ or 62.5 per cent.

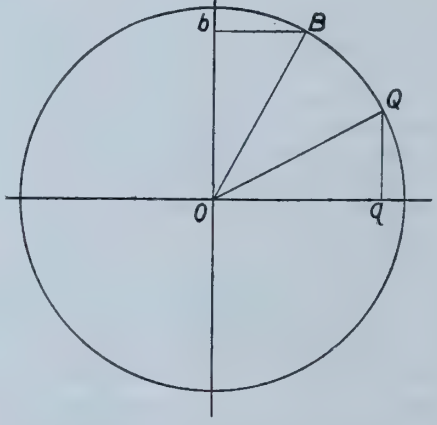


FIG. 33.—SIMPLE PROOF OF THE PRINCIPLE OF THE BILGRAM DIAGRAM.

Ratio of Expansion.

Ratio of expansion or the number of expansions is the number of times the volume of the steam at the end of the stroke plus the clearance volume is that of the steam plus the clearance volume at the point of cut off; or it is the ratio between the volume of the steam in the cylinder and clearance space at the end of the stroke and the volume of steam in cylinder and clearance at the point of cut off. It is the reciprocal of the real cut off. Thus, if the volume of the steam in cylinder and clearance at end of stroke be 2,400 cu. ins., and at the point of cut off 1,200 cu. ins., the ratio of expansion would be $\frac{2400}{1200}$ or 2 and the real cut off would be $\frac{1200}{2400} = 1/2$ or 50 per cent.

VALVE DIAGRAMS.

Most of the calculations pertaining to valves and their relation to the other parts of the engine involve difficult mathematics. For this and other reasons it is usual to obtain results graphically by means of diagrams—that is, by drawing all parts full size or to a scale and actually measuring lengths with a rule. Valve diagrams then represent general practice as follows:—

(1)—To determine lap, displacement, angular advance and other facts in connection with existing valves.

(2)—To design and proportion certain parts of new valves and their gearing.

A number of different diagrams are employed for this purpose, chief of which are the Zeuner, which is used mostly in Europe, and the Bilgram, which is quite popular in America. For a number of reasons the latter is easier for mechanics to understand and apply, and, throughout the course, we will confine ourselves largely to it.

The Bilgram Diagram.

This diagram was invented by Hugo Bilgram, of Philadelphia, and depends for its proof upon a geometrical proposition which says that if two angles and a side of one triangle be respectively equal to the corresponding two angles and side of another triangle, the two triangles are equal in every respect. This is seen in Fig. 33. In the triangles bBO and QOq, the side BO is equal to QO, as they are radii of the same circle. The angle QOq has been made equal to the angle BOb and the angles BbO and QqO are equal, because they are right angles. Now according to geometry, the two triangles are equal in every way—that is, the line bB is equal to Qq.

In the previous article we determined the angle of advance by drawing from (b) a line bB equal to the lap plus lead and joining BO, the angle of advance being bOB. We have just seen that the lap plus lead can just as well be measured up from (q), and can be represented by the line qQ. The angle of advance now is QOq instead of BOb. This is what is done in the Bilgram diagram.

In connection with the designing of valves, all or some of the following facts are easily obtained:—

(1)—The throw of the crank may be determined from the stroke of the engine.

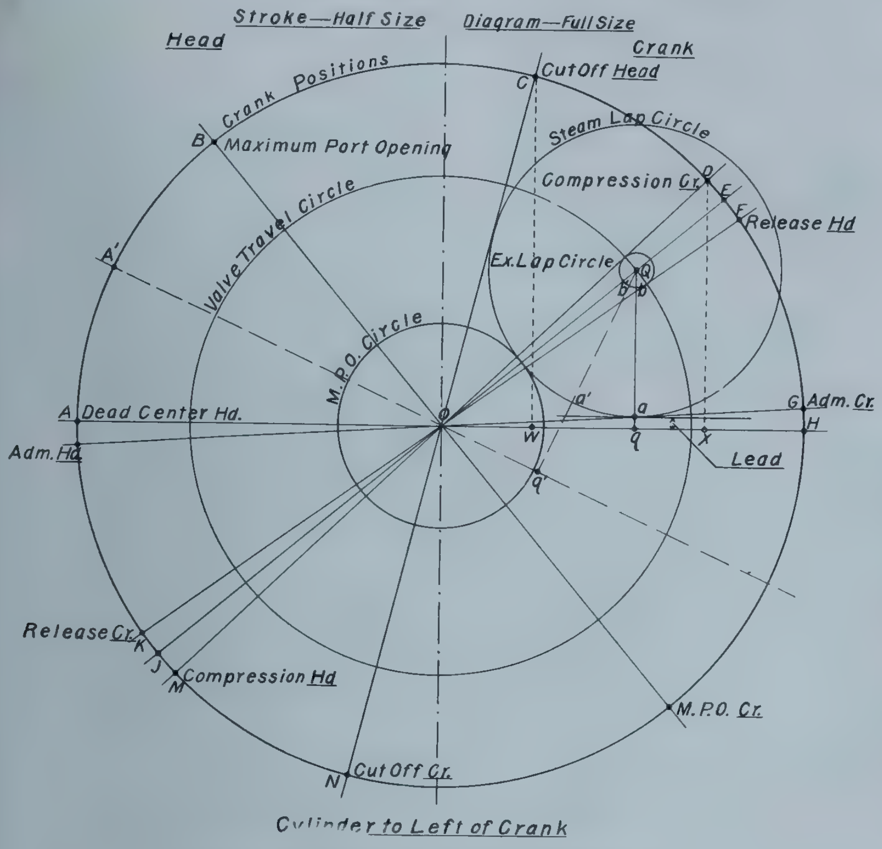


FIG. 34—COMPLETE BILGRAM DIAGRAM.

(2)—The maximum port opening is usually determined by calcuation, or, if the same as the port, its width can be measured.

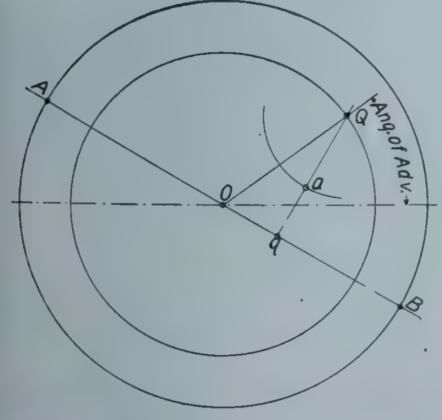


FIG. 35.—USE OF BILGRAM DIAGRAM TO DETERMINE DISPLACEMENT AND PORT OPENING.

(3)—The throw of eccentric and travel of valve can be measured.

(4)—The lead is determined by judgment and practice of the designer.

(5)—The point of cut-off—that is, the proportion of the stroke at which cut-off takes place, is usually a matter for the designer's judgment.

(6)—The point of compression or the point in the stroke at which exhaust closes.

It may be required to find, by means of the diagram, some of the above and any other information, such as inside and outside lap, angle of advance, crank positions for the different events of the engine stroke, positions of the valve corresponding to various positions of the crank, width of port opening at any point in the stroke, etc.

The Complete Diagram.

The diagram must be accurately drawn to some scale. Either full size or an enlarged scale is best. The crank pin circle with its diameters may be drawn to a different scale from the rest of the diagram, thus in the illustration Fig. 34 the stroke is represented half size and the valve diagram is drawn full size. Proceed as follows:—

(1)—Draw a horizontal centre line AH to represent the engine stroke, and, using this line as a diameter, draw the **crank pin circle** as shown to the predetermined scale.

(2)—From the same centre and with a diameter equal to the travel of the valve construct the **valve travel circle.** Its radius will, of course, be equal to the eccentricity.

(3)—Still using the same centre, draw the **maximum port opening circle** with a radius equal to the greatest port opening.

(4)—Assuming that the cylinder is to the left of the crank, and that we are considering the forward stroke, measure off from A the proportion of the stroke at which cut-off is to take place—namely, Aw, which is $\frac{5}{8}$ of the stroke, and, therefore $\frac{5}{8}$ of the distance AH. From (w) draw a vertical line to cut the crank pin circle at C. This point C represents the position of the crank pin when cut-off occurs. Through C draw a crank line CN. By a crank line is meant a diameter of the crank pin circle through any crank position.

(5)—From the dead centre crank line measure upwards a distance (qa) equal to the lead, and through (a) draw a short horizontal line. Call this the **lead line**

(6)—Draw in the **steam lap circle.** Its centre must be on the valve travel circle, and it must touch three points—namely, the lead line at (a), the M.P.O. circle, and the cut-off crank line.

(7)—In the same way as the point of cut-off was determined, measure from A a distance Ax representing the proportion of the stroke at which compression is to take place. Through (x) draw a vertical line cutting the crank circle at D. This is the crank position for compression in the other end of the cylinder. For head end compression, draw a crank line through D, which will cut the crank circle at the desired crank position M.

(8)—From the same centre as the steam lap circle draw the **exhaust lap circle** so that it will just touch the compression crank line. The exhaust lap is represented by the radius of this circle. Draw a crank line FK so as to touch the other side of the exhaust lap circle. This gives the two crank pin positions for **release**—namely, F and K. The crank position for admission depends upon the lead; hence, draw a crank line through the lead line at the point (a) and the centre of the crank circle C. This gives the two points of admission G and

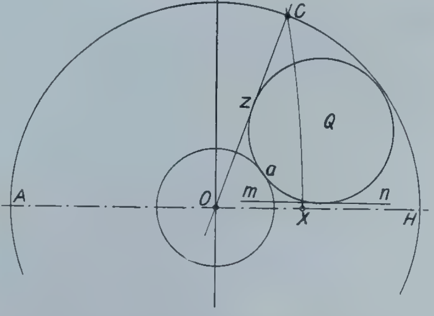


FIG. 36.—USE OF BILGRAM DIAGRAM TO DETERMINE POINT OF CUT OFF.

I. Providing that the ports, lap, etc., are the same for both ends of the valve, the crank positions for similar events in opposite ends of the cylinder will be found at opposite ends of diameters of the crank pin circle.

Studying the diagram, Fig. 34, a number of facts will be understood. The crank pin circle, crank lines and all lines pertaining to the crank are drawn to a certain scale. All other lines relate to the valve, and, therefore, should be drawn to a uniform scale, which may be the same as for the crank parts or different. **Throw** of the eccentric or valve **displacement** is represented by the **radius** of the valve travel circle, and the **travel** of the valve is represented by its **diameter.** By displacement of the valve is **meant** the distance it moves in either direction from its mid-position. The maximum port opening is represented by the radius of **the M.P.O. circle.**

The maximum port opening is always less than the width of the cylinder port in good design as the latter must be wide enough to accommodate the exhaust steam.

Steam lap is represented by the **radius** of the steam lap circle and exhaust lap by the **radius** of the exhaust lap circle. Lead is represented by the distance of the lead line above the horizontal diameter or base line. Note carefully that the radius of the valve travel circle is equal to the radius of the M.P.O. circle plus the radius of the steam lap circle. The travel of the valve is, therefore equal to twice the lap plus the maximum port opening.

The displacement of the valve when the crank is at A or on dead centre, is equal to the distance Qq or **the lap plus the lead.** The line Qq is a **vertical** from the centre of the steam lap circle to the crank line for the above crank position. **Qa represents the lap,** while (aq) represents the port opening, which in this case is equal to the lead. For any other crank position, such as A^1, the displacement is equal to the vertical Qq^1 on the crank line as before. The lead is Qa^1 and the amount of port opening is (aq).

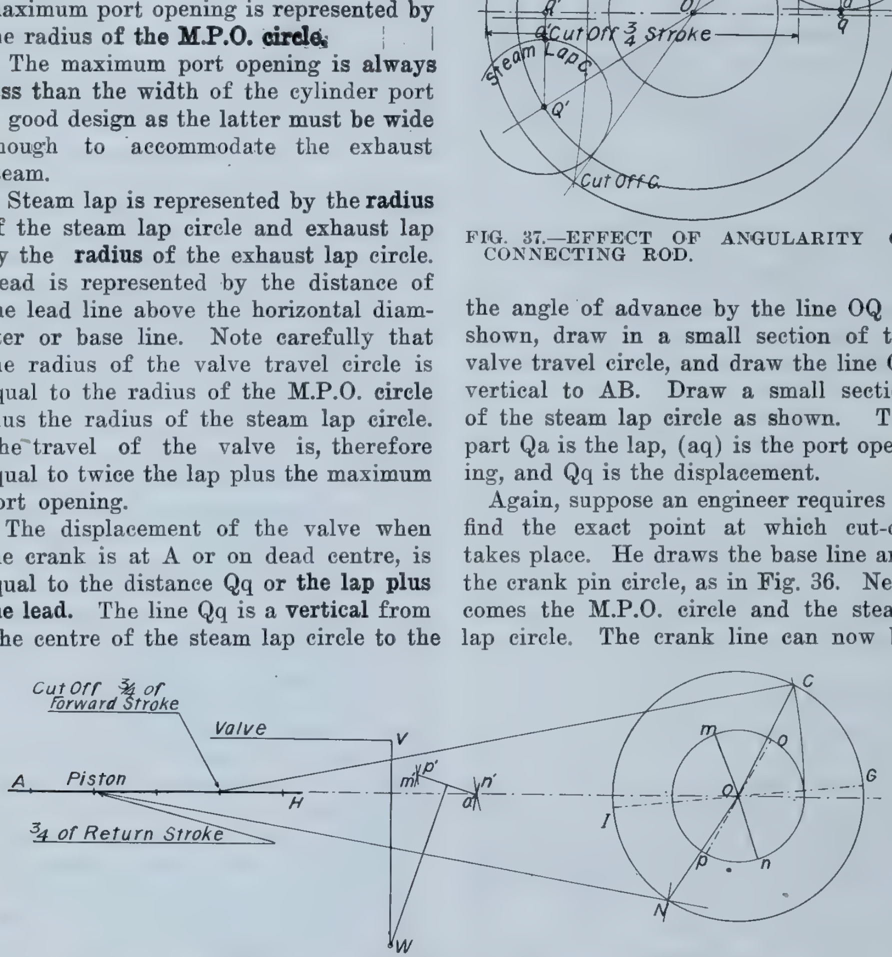


FIG. 38.—EQUALIZING CUT OFF BY MEANS OF ROCKER ARM

At the crank position B, the vertical QO on the crank line reaches its greatest length; hence, the crank position B is the position for maximum port opening. At C the vertical distance is equal to Qz., Fig. 36, which is the same as the lap, therefore, there is no port opening, and C is the point of cut-off. This same reasoning can be carried out in connection with the exhaust lap, but is never required.

In the cut, Fig. 34, the complete diagram is represented. This, however, is rarely required. For instance, if the port opening or displacement only is required for a given crank position, such as A, Fig. 35, all that is required is to draw the crank line for this position, lay off the angle of advance by the line OQ as shown, draw in a small section of the valve travel circle, and draw the line Qq vertical to AB. Draw a small section of the steam lap circle as shown. The part Qa is the lap, (aq) is the port opening, and Qq is the displacement.

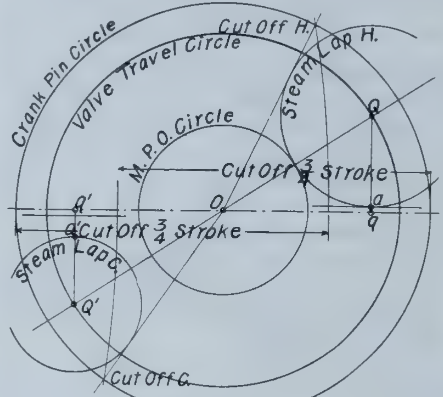


FIG. 37.—EFFECT OF ANGULARITY OF CONNECTING ROD.

Again, suppose an engineer requires to find the exact point at which cut-off takes place. He draws the base line and the crank pin circle, as in Fig. 36. Next comes the M.P.O. circle and the steam lap circle. The crank line can now be drawn, touching the steam lap circle at (z). This will give the crank pin position C for cut-off, from which the piston position can be found by drawing the arc as shown from a centre on the base line and with a radius equal to the length of the connecting rod to the scale of the crank pin circle. The position of the piston will be at (x). The distance Ax can now be measured, and the percentage of the stroke which it represents is easily calculated.

These statements are correct only in cases where a Scotch yoke or similar form of cross head is used. The effect of the conecting rod will be dealt with in the next number of this series.

PROTECTION OF CONDENSER TUBES.

THE methods in use for the protection of condenser tubes are electro-chemical in nature; they depend either on the use of some metal, such as zinc, iron, or aluminum or its alloys, which is electro-positive to brass, and which will consequently set up an electrical current when both are connected together and immersed in sea water; or on the use of a dynamo to pass the current to the brass.

In principle the two methods are identical, viz., that of making brass which it is desired to protect, a cathode at which there will be a tendency for the liberation of hydrogen, while oxygen will tend to be set free at the anode. This anode may consist of any of the metals mentioned above. The idea is to concentrate corrosion on the anode, which is sacrificed to protect the cathode.

The metal zinc has been largely employed for anodes, both for the protection of boilers and condensers. In the case of the latter, it is placed in the water ends and is securely bolted to the tube plates. At first sight it would appear to be a more suitable metal than iron, since it is more electro-positive, but in practice this does not prove to be the case. There appear to be two reasons for this. The first is that the zinc gradually becomes covered with a fairly adherent layer of oxide, which itself is electro-negative to brass, and is a poor conductor of electricity. Thus the protective action of the zinc soon ceases, and might even be reversed but for the poor conducting properties of the oxide. The second reason is that the consumption of zinc is found to be very great, far greater than that demanded by the requirements of electro-chemical protection. It seems probable that the zinc is subject to auto-corrosion due to the action of the zinc-oxy-chloride which adheres to the metal.

For the protection of condensers zinc has been largely replaced by iron, which is not only cheaper but more efficacious. The iron is used generally in the form of slabs, which are placed in the water ends of the condenser, and are attached by bolts to the tube plates. If any electro-chemical action is to occur, it is obviously necessary to ensure that the connection between the iron slabs and the tube plate be thoroughly satisfactory. It is, of course, possible that the mere presence of iron slabs in the water ends of a condenser might give rise to a certain amount of protection by depriving the water of a large proportion of its oxygen, which will go to form rust. If this be so, no special care need be taken to ensure satisfactory electrical connections.

Series of Practical Questions and Answers for Engineers

Every care is being taken to include only pertinent practical questions, and give same direct, reliable answers. Catch questions will be avoided. Attention is drawn to the alternating course in arithmetic, a concurrent study of which is recommended with that of the Question and Answer Series.

PROBLEMS RELATING TO GEARS

THE introduction of special machinery has largely obviated the necessity of gear calculations. This pertains mostly to the laying out of tooth forms. Problems in connection with diameters, pitches, etc., still often come to the average mechanic. The object of the particular shapes adopted for the teeth is to produce a smooth, continuous, true rolling motion between the wheels, and there are in use two general methods of producing these forms—namely, form milling and generating. The first requires a rotary cutter of the correct shape to plow out the space between two adjacent teeth, while in the latter a reciprocating tool is shaped and fed in such a way as to take the place of a rack tooth in mesh with the gear being cut. The result is a space that will accommodate the rack tooth throughout its whole passage through the gear.

In order to understand gear calculations, certain terms must be understood. Pitch diameter or diameter alone is the diameter of the gear if it were considered as a cylinder without teeth simply rolling against its mate without slipping. The thickness of the tooth is its thickness measured along the pitch circle. The addendum is that portion of the tooth which extends outside of, and the root is that portion which is inside of the pitch circle. The surface of the tooth below the pitch circle is called the flank, and that above is called the face. Circular pitch is the distance from the centre of one tooth to the centre of the next measured along the pitch circle. Diametral pitch is the number of teeth of a gear for every inch of pitch diameter—that is, the total number of teeth divided by the pitch diameter in inches.

Question.—A pinion having 12 teeth meshes with a gear having 90 teeth. What is the ratio of pinion to gear?

Answer.—Ratio $= \frac{90}{12} = 7.5$, or, in other words, the pinion will make 7½ times as many revolutions as the gear.

* * *

Question.—A gear of 120 teeth drives one of 60 teeth, which is keyed to the same shaft as an 80-tooth gear. This, in turn, drives another of 48 teeth. What is the ratio of the gearing If the 120-toothed gear made 30 revolutions per minute, what would be the speed of the one with 48 teeth?

Answer.—Ratio of gearing

$$= \frac{120}{60} \times \frac{80}{48} = \frac{10}{3} = 3\,1/3.$$

Speed of driven gear $= 30 \times \frac{10}{3} = 100$ r.p.m.

* * *

Question.—A driving shaft is fitted with a 36-tooth pinion. It is required to drive another shaft at one-sixth the speed, with available gears increasing by 4 from 24 to 72 teeth.

Answer.—Ratio = 6. To drive a shaft directly from the 36-tooth pinion would require a gear of 36×6=216 teeth, which is not available. Divide the ratio into 2, say 3 and 2. The first could be obtained by a combination of the 24 with gear of 24×3=72 teeth, while the second could be got by a number of combinations, say 32 and 64. The 24-toothed pinion would drive the 72-toothed gear, and the 32-toothed pinion fastened to the same shaft as the 72 would drive the 64-toothed gear. The ratio then is

$$\frac{72}{24} \times \frac{64}{32} = 6$$

* * *

Question.—What would be the circular pitch of a gear whose diametral pitch is 4?

Answer.—The diametral pitch multiplied by the circular pitch is always equal to 3.1416; therefore, circular pitch is $\frac{3.1416}{4} = .7854$ in.

* * *

Question.—A 6-pitch gear has 240 teeth. What is its pitch diameter?

Answer.—As the gear has 6 teeth for every inch of diameter, then diameter

$$= \frac{240}{6} = 40 \text{ inches.}$$

* * *

Question.—A 2-pitch gear is to be made with 36 teeth. What should be the diameter of the blank?

Answer.—Rule—Add 2 to the number of teeth and divide by the pitch, hence

$$\text{Outside diameter} = \frac{36+2}{2} = 19 \text{ inches.}$$

* * *

Question.—What is the circular pitch of a wheel having 240 teeth and a diameter of 60 inches?

Answer.—Circular pitch $= \frac{3.1416}{\text{Diametral pitch}}$

$$\text{Diametral pitch} = \frac{\text{Number of teeth}}{\text{diameter}}$$

$$= \frac{240}{60} = 4$$

$$\text{Circular pitch then} = \frac{3.1416}{4} = .7854$$

* * *

Question.—What is the distance between centres of two gears of 1 inch circular pitch and having 64 and 24 teeth respectively?

Answer.—Addendum = flank or working depth of tooth. Total depth of tooth = addendum plus flank plus clearance. Rule for distance between centres is: Multply working depth by one-half the total number of teeth in both gears.

Working depth $= \frac{1}{\text{diametral pitch}}$, and diametral pitch.

$= \frac{3.1416}{\text{Circular pitch}}$. Working depth, therefore, is $\frac{\text{Circular pitch}}{3.1416}$

$$= \frac{1}{3.1416} = .3183$$

Distance between centres is then

$$\frac{64+24}{2} \times .3183$$

$$= 44 \times .3183 = 14.005 \text{ inches.}$$

* * *

Question.—If the distance between centres of two gears is 24 inches and their speed ratio is 4 to 1, what would be the diameters of the two gears?

Answer.—Rule, for small gear diameter

$$= \frac{2 \times \text{distance between centres} + 1}{1 + \text{ratio}},$$

or diameter of small gear

$$= \frac{2 \times 24 \times 1}{1+4} = \frac{48}{5} = 9.6 \text{ inches.}$$

For large gear, diameter

$$= \frac{2 \times \text{centre distance} \times \text{ratio}}{1+\text{ratio}}$$

$$= \frac{2 \times 24 \times 4}{1+4} = \frac{192}{5} = 38.4 \text{ inches.}$$

POWER CALCULATIONS.

WORK is measured by taking account of force and distance. The British unit of work is the foot-pound or one pound of force through one foot of distance. When power, or the rate of performing work is required, another dimension must be taken into account. This is time. Thus power is the ability to do a certain amount of work in a stated time. The unit of time varies, but the minute is usually adopted. That is, a horse power represents 33,000 foot-pounds of work performed in one minute. This may mean the lifting of 33,000 pounds one foot high, 330 pounds 100 feet high, or it may represent the moving of a body 1,000 feet in a horizontal direction against a frictional resistance of 33 pounds. It matters not whether the direction of the applied force is vertical, horizontal or circular so long as the three dimensions are known namely, its value in pounds, the distance it moves in feet and the time in minutes required to travel the above distance.

* * *

Question.—An elevator lifts 21 people 60 feet in 3 minutes. Counting 12 people to the ton, what is the work done and what is the power of the machine?

Answer.—If 12 people weigh 1 ton, 21 would weigh $\frac{21}{12}$ tons or $\frac{21}{12} \times 2{,}000$ pounds $= 3{,}500$ pounds.

$3{,}500 \times 60 = 210{,}000$ foot-pounds, which is the work done.

210,000 foot-pounds in 2 minutes = 105,000 foot pounds per minute, and as one horse power = 33,000 foot-pounds per minute, therefore the power of the elevator is

$\frac{105{,}000}{33{,}000} = 3\frac{2}{11}$ horsepower.

* * *

Question.—How fast could a 3-ton elevator be raised by a 4 h.p. motor, considering the unbalanced weight of the elevator to be 500 pounds and the efficiency of the machinery to be 75 per cent.?

Answer.—A four h.p. motor with gearing of 75 per cent. efficiency could perform $\frac{33{,}000 \times 4 \times 3}{4} = 99{,}000$ foot-pounds of work.

The loaded elevator weighs $(3 \times 2{,}000) + 500 = 6{,}500$ lbs. With a power of 99,000 foot-pounds per min., this load could be raised $\frac{99{,}000}{6{,}500} = 15.23$ feet per min.

* * *

Question.—A pump working 8 hours per day is required to keep a tank, which is elevated 60 feet, full of water. The tank is 14 feet in diameter, 16 feet high and is three-quarters emptied every day. With friction and mechanical losses amounting to 40 per cent., what size motor would be required to operate the pump?

Answer.—The volume of the tank is $7^2 \times \frac{22}{7} \times 16 = \frac{7 \times 7 \times 22 \times 16}{7} = 2464$ cu. ft.

Weight of water $= 2{,}464 \times 62\frac{1}{2} = 154{,}000$ pounds or $\frac{3}{4} \times 154{,}000 = 115{,}500$ pounds to be raised in 8 hours. The height is $60 + 16 = 76$ feet. 115,500 pounds in 8 hours $= \frac{115{,}500}{8 \times 60} = 240.625$ pounds per min. To raise this 76 feet requires 76×240.625 foot pounds or $\frac{76 \times 240.625}{33{,}000}$ h.p. With a loss of 40 per cent. The rating of the motor would be, $\frac{76 \times 240.625 \times 100}{33{,}000 \times 60} = .923$ h.p.

* * *

Question—If it requires 300 pounds pressure on the tool of a lathe to take a cut 3-16 inch deep at a 32 feed, what horse power motor would be required to operate the machine. The diameter of the work is 28 in., the speed of the driving pulley which is geared 4 to 1 is 40 r.p.m. and the efficiency of the gearing is 85 per cent.

Answer.—The work makes $\frac{40}{4} = 10$ r. p. m. Circumference of the work is $\frac{28}{12} \times \frac{22}{7} = \frac{22}{3} = 7\frac{2}{3}$ feet. Speed, therefore, is $7.33 \times 10 = 73.3$ ft. per min. Force is 300 pounds, and horse-power then is $\frac{73.3 \times 300}{33{,}000} = \frac{73.3}{111} = 666$ h.p. On account of the gearing losses, this represents 85% of the required power. Power needed then is $\frac{.666}{85} \times 100 = .784$ h.p.

* * *

Question.—The arm of a prony brake is 3 ft. long. If the engine run at 120 r.p.m. and the load on the scale be 20 pounds, what actual power is the engine developing?

Answer.—The number of foot-pounds developed would be the circumference of a circle of 3 ft. radius multiplied by the r.p.m., multiplied by the load on the scale. This is $6 \times \frac{22}{7} \times 120 \times 20$, and horse-power $= 6 \times \frac{22}{7} \; \frac{120 \times 40}{33{,}000} = 2.74$ h.p.

* * *

Question.—Instruments show that the electrical power input to a boring mill is 27.8 amperes at 220 volts. A previous test of the motor showed the stray power and other losses to be 3.8 amps. What horse-power is required to operate the machine?

Answer.—One horse-power = 746 watts. Number of watts used is $24 \times 220 = 5{,}280$.

Amount of horse-power is $\frac{5280}{746} = 7.07$ h.p.

* * *

Question.—In the above example, the large gear is 35 inches in diameter. If the speed be 1½ r.p.m. what is the direct pressure against the gear teeth?

Answer.—The circumference of the gear is $\frac{35}{12} \times \frac{22}{7} = \frac{55}{6}$ and surface speed $= \frac{55}{6} \times \frac{3}{2} = \frac{55}{4} = 13.75$ ft. per min.

7.07 horse-power $= 7.07 \times 33{,}000 = 233{,}310$ foot-pounds.

Pressure on gear teeth $= \frac{233{,}310}{13.75} =$ 16,968 pounds or 8½ tons.

* * *

Question.—A triple threaded worm drives a 72-toothed gear. How many revolutions will be made by the gear for every 100 made by the worm?

Answer.—For every revolution of the worm, the gear advances three teeth. For 100 revolutions of the worm the gear would advance $3 \times 100 = 300$ teeth or $\frac{300}{72} = 4.16$ revolutions.

* * *

Testing a Boiler Performance.—One of two 250 horse-power boilers failed to develop its rated capacity. There being no flue gas analyzing outfit handy, the engineer arranged to determine the performance of the boilers. A small hole was drilled in the rear wall of the boiler setting just below the line of lower tubes, and a small iron rod was inserted a short distance under the boiler. With the highest rate of combustion, the rod would melt at the end; with fairly good combustion, the rod became white hot; with excess air coming through the grate and a large percentage of the gas passing up the stack, the rod remained black or red. Because of these tests the use of one boiler was discontinued, resulting in a saving of approximately 1 lb. of coal per kilowatt hour.

* * *

Captain T. C. Irving, Jun., vice-president of the Robt. W. Hunt & Co., inspecting engineers, Toronto, has left with the 2nd Company Canadian Engineers for Val Cartier, Que.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

VERTICAL DUPLEX PISTON PUMP

THE cut herewith illustrates a vertical duplex piston pump, manufactured by the Smart-Turner Machine Co., Hamilton, Ont. These pumps, being vertical, take up less space in the engine room and do away with the tendency—which is present in horizontal pumps—to wear on the bottom side of the steam and water cylinders. This has a direct effect upon the life of the plunger.

VERTICAL DUPLEX PISTON PUMP.

It will be seen that the suction and discharge valves are so placed that they are readily accessible, and that it is not necessary to open up the whole of the valve chamber to examine or repair any particular valve. These pumps are suitable for either stationary or marine service.

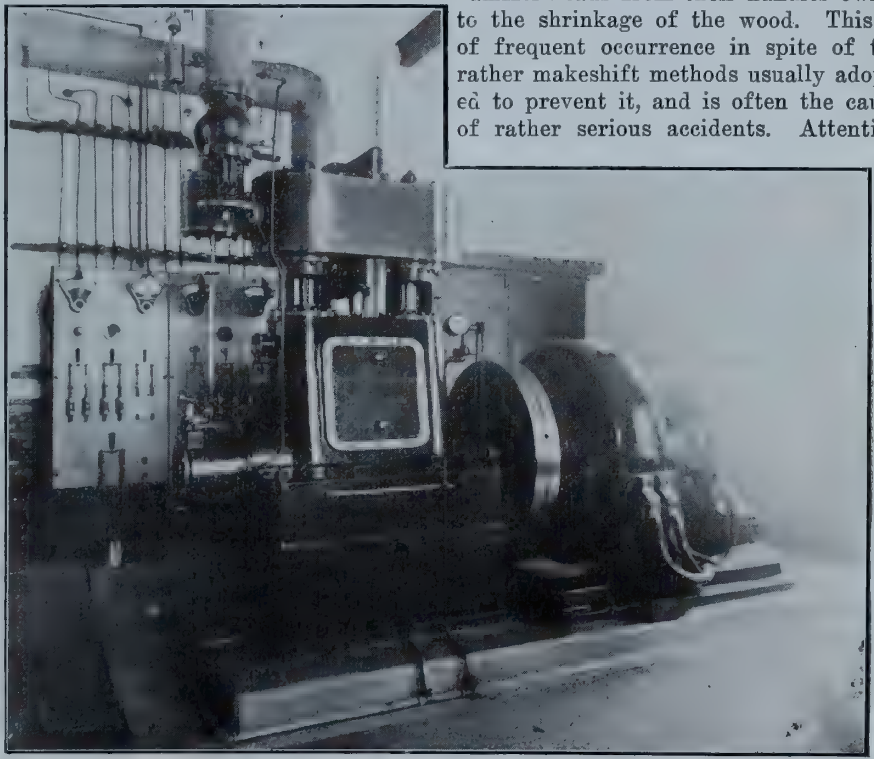
* * *

ENGINE AND GENERATOR INSTALLATION.

THE Imperial Oil Co., of Sarnia, Ont., recently added to their electrical equipment, the following power generation unit. It consists of a direct current generator, 125 k.w., 450 r.p.m., 125 volts, built by the Canadian General Electric Co., Toronto, and driven by a Goldie & McCulloch, Galt, Ont., vertical twin cylinder, non-condensing, forced lubrication engine, taking steam of 80 lbs. pressure at throttle valve and exhausting against 8 pounds back pressure.

This twin engine has been specially developed to meet cases where considerable power is required, with only a low steam pressure available at the throttle valve, or where the engine is exhausting against very considerable back pressure. Features of this engine are the small floor space required for the horse power developed and the great reduction in cost of engine and generator due to the high speed at which they can be operated.

The switchboard, also built by the Canadian General Electric Co., consists of Blue Vermont marble panels, arranged so that each panel contains all the necessary equipment for control, consisting of one d.c. generator, and 3 feeder circuits. For each generator there is provided an ammeter and voltmeter, rheostat, main and equalizer switches with fuses, and for each generator circuit one double pole, single throw knife switch with enclosed fuses.

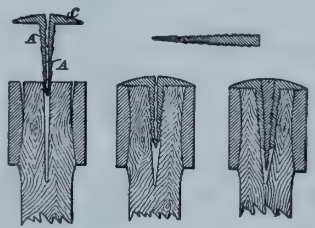


ENGINE AND GENERATOR INSTALLATION.

* * *

EXPANDING WEDGE FOR HAMMER HEADS, ETC.

NOT the least of the many little annoyances the mechanic meets with in the course of his work is the loosening of hammer-heads from their handles owing to the shrinkage of the wood. This is of frequent occurrence in spite of the rather makeshift methods usually adopted to prevent it, and is often the cause of rather serious accidents. Attention



FIGS. 1, 2, 3, 4. EXPANDING WEDGE FOR HAMMER HEADS, ETC.

is therefore called to a patented expanding wedge for the purpose of fixing the heads of hammers, axes, picks, and other similar tools. The inventor claims that the heads are thereby fixed with absolute security, so that the time wasted in tightening them up while work is in progress is saved, and the possibility of accidents arising from the heads flying off and injuring persons or property is eliminated.

The accompanying illustration, which is more or less self-explanatory, shows the design of the wedge and the method of applying it to fix a hammer-head. The device will be seen to consist of a pair of tapered side-plates lettered A in Fig. 1, pinned together at their thin ends for convenience in fixing, and a central wedge, Fig. 2, the object of which is to expand the side plates. The inner and outer faces of the side plates, and the two faces of the wedge, are serrated, as shown, so that slipping of any part is prevented.

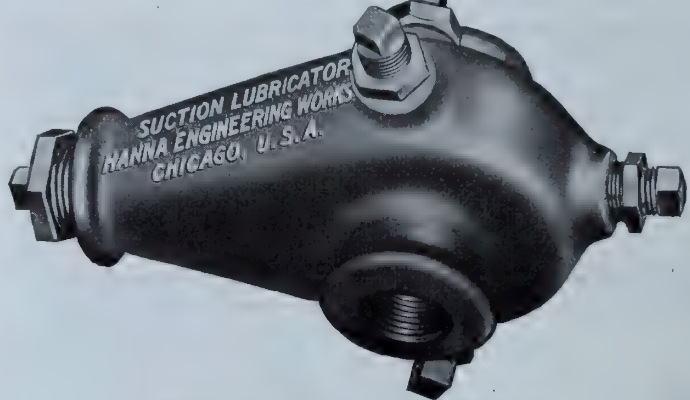
To apply the device, a saw cut a little deeper than the thickness of the head is first made in the end of the handle, as shown in Fig. 1. The head having been placed in position on the handle, the side plates are driven into the saw cut so that the projecting flanges are flush with the end of the handle and the head, as shown in Fig. 3. The central wedge is then driven in between the side plates into the position shown in Fig. 4. This operation bursts or shears the connection between the side plates, and forces them apart, so that the wood is expanded sufficiently to fill the hole in the head completely; the latter is therefore quite immovable. If, after a time, any further shrinkage of the wood should occur, it can be taken up very easily by driving the central wedge down another notch, and this operation can be repeated several times if necessary.

These wedges are made by the Patent Expanding Wedge Co., 114 Great Portland street, London, W., in fourteen different sizes, of which the smallest measures 15-32 in. by ⅞ in., and is suitable for a head weighing ½ lb.

NEW SUCTION LUBRICATOR

A NEW and novel lubricator, made in three sizes for ¾-in., 1-in. and 1½-in. pipe connections, for use particularly on devices operated by compressed air, has just been brought out by the Vulcan Engineering Sales Co., Chicago, and is illustrated in the accompanying cut. The principle involved is one of suction. A chamber containing an absorbent is kept saturated from a large oil storage chamber surrounding it, and air passing through the lubricator becomes sufficiently charged with oil to properly lubricate all surfaces with which it subsequently comes in contact.

This device is entirely automatic, because suction action takes place the instant air moves, and it ceases immediately the air is shut off. The take-up of oil is extremely moderate though continuous when air is being used. The apparatus can be attached to the air line in any position and operates in any plane or at any angle and can be filled in no matter what position. It is claimed, therefore, to be universal and fool-proof, and likely to prolong the life of pneumatic equipment, besides conserving the amount of lubricant used, thereby increasing efficiency and reducing maintenance costs.



NEW STYLE SUCTION LUBRICATOR.

* * *

C. G. E. Patriotic Offer—The Canadian General Electric Co., Toronto, gave tangible expression in the accompanying telegram to Premier Borden of their desire to be of service to the Empire and the Dominion in the present crisis, and, needless to say, acceptance was gratefully acknowledged:

"Toronto, August 6th, 1914.

"The Right Honorable
Sir Robert L. Borden,
Prime Minister, Ottawa, Ont.

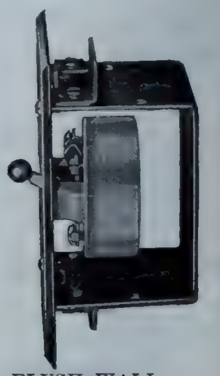
"The Board of Directors of the Canadian General Electric Co., after full consideration, and having regard to the present serious war situation, have resolved to submit to your Government an offer to raise, equip, and pay the salaries of a company of twenty-five skilled electrical and mechanical operatives who would be available for service in any part of the Dominion, and be under the control of the Minister of Militia as part of the Canadian forces. Probably their services could best be uitlized in the erection, repair and maintenance of wireless telegraph stations, cable stations, bridges, transport vehicles, artillery, etc.

"(Sgd.) Frederic Nicholls,
"President."

A NEAT ELECTRIC SWITCH.

THE Duncan Electric Co. of Montreal have placed on the market a new line of standard electric fixtures. Their policy has been to simplify the various pieces, the new rosettes, sockets, extension plugs, switches, etc., being planned to give the least possible trouble to wiremen.

The latest addition to the list is a switch which when connected up is flush with the wall. Through a neat little rectangular-shaped brass plate a small brass lever extends, on the end of which is screwed a spherical brass ball; the switch being operated by throwing the lever up or down. The features of the switch are its ornamental flush mounting on the wall and the simplicity of its parts. The little switching lever is insulated from the current by the introduction of a porcelain link in the operating levers.



FLUSH WALL SWITCH.

A NEW STARTING UNLOADER.

TO maintain a uniform pressure in the receiver and pipe lines, and to prevent the engine or motor driving the air compressor from stalling through overload, it is essential that the compressor, whether steam, gas or motor-driven, be provided with some device that will unload it, when the desired receiver pressure is attained, and start the air into the receiver again when the pressure has fallen but a small amount below maximum or any predetermined point.

An interesting starting unloader for motor-driven compressors, in which the motor current is cut out or in to stop or start the compressor when a maximum or minimum load is reached, has recently been added to the field of air controlling devices by George M. Richards, formerly of Erie, Pa. In this latest apparatus the unloading action is obtained by the velocity of the air pressure passing through the chamber and the variation of the receiver pressure. The compressor is completely unloaded when speed is reduced about 25 per cent., and by this action any recoil on the last revolution experienced when stopping against a load is obviated.

When the motor starts the air is by-passed to the atmosphere, until the desired speed is obtained, at which point the by-pass valve closes and the air passes to the receiver until the predetermined pressure at which current is cut out is reached. Then the by-pass is opened by the receiver pressure, via the trigger, against the unloading piston. The intake air has then, with the compressor unloaded, a practically free passage through the cylinder, with resultant cooling effect until the machine stops. The different loading and unloading operations are dependent upon the speed of the machine, and, therefore, entirely automatic. When the current is cut out and the compressor slows down, the by-pass valve opens automatically and unloads before the compressor stops. When the current is cut in, compression does not occur until the motor has obtained the desired speed. The principal advantage claimed for this new unloader is the fact that a compressor equipped with it will require very much less power to start it. Such a compressor can, therefore, be driven by a motor of much less power than ordinarily used. The operating parts of this new unloading device are few and simple, and consist of a by-pass valve (3), a check valve (15), unloading piston (6), and trigger (35). The detailed operation in connection with Figs. 2, 3 and 4 is as follows:—

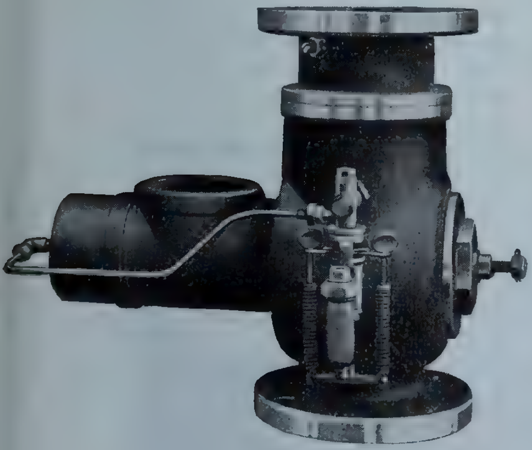


FIG. 1. STARTING UNLOADER.

Operation Features.

The air from the discharge port of the compressor enters at the bottom of the unloader and passes through the open valve (3), Fig. 3, to the atmosphere until the by-pass valve (3) is closed by the velocity overcoming the tension of spring (10). It then lifts check valve (15) and passes to the receiver connected to the top of the unloader. Check valve (15) is controlled by dash pots (16) and (19) to prevent its seating at every stroke; the time of seating being regulated by vent screw (21), Fig. 4. The small valve (22) is a vacuum breaker to allow the check valve to lift freely, while (23) is a fixed pin for holding the dash pot bushing in place.

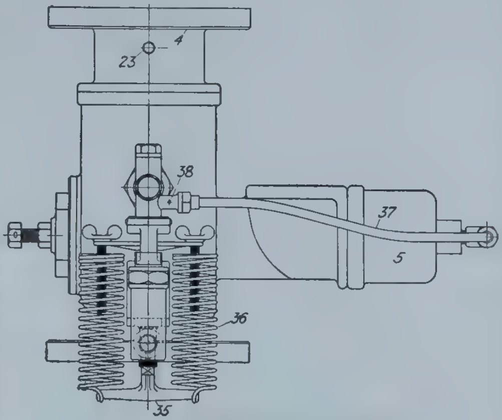


FIG. 2. STARTING UNLOADER.

The receiver pressure to operate the trigger mechanism enters trigger cylinder (29) through port (40) and filter (39), Fig. 4, and constantly acts on piston (30) to close bleeder valve (32), and closes valve (32) when pressure is within 3 lbs. of the maximum. As soon as the motor current is cut out and the speed is reduced about 25 per cent., the check valve (15) seats and presses down lever (25) and lifts pilot valve (26), admitting pressure from chamber (1) through tube (37), Fig. 2, behind piston (6), Fig. 3 in cylinder (5), and by-pass valve (3) is forced open by piston rod (7), Fig. 3.

When the receiver pressure has dropped about 3 lbs., or any predetermined amount, tension springs (36), Fig. 2, pull down the trigger piston (30), Fig. 4, and bleeder valve (32). After starting again and the velocity has closed by-pass valve (3), the accumulating pressure in the valve chamber (1) blows out of the pilot valve (26) and bleeder valve (32) until check valve (15) lifts and lever (25) releases pilot valve (26) and allows it to close. The tension on springs (36) is usually so adjusted that the pressure under piston (30) closes bleeder valve (32) when within 3 lbs. of maximum and opens the valve when the pressure has dropped about 3 lbs. In order to prevent any possible leakage past pilot valve (26) from acting on piston (6) and forcing by-pass valve (3) open, a minute hole is drilled at (38), Fig. 2, to permit this air to escape.

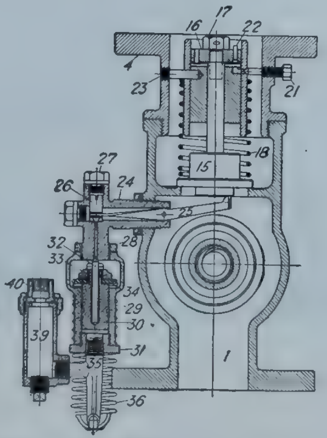


FIG. 4. STARTING UNLOADER.

Just before unloading occurs, the bleeder valve (32), Fig. 4, closes and allows the full pressure to act on piston (6). While loading it is kept open to prevent the pressure from acting on the piston. The baffle washer (34) is to prevent cylinder oil which may blow out of the bleeder valve from coming in contact with piston (30).

The unloader is generally placed on the discharge port of the compressor cylinder, but may be placed anywhere in the discharge line near the cylinder, and efficient operation will not be hindered. The adjustment of the unloader to the required condition of the compressor is particularly simple. When the compressor is near the desired speed, lock nut (13) is backed away and thrust screw (14) is turned in, thus moving by-pass valve (3) towards its seat till it closes automatically by the velocity of the escaping air, then the lock nut is set up. When the receiver pressure is within about 3 lbs. of the maximum or cutting out point, then springs (36) on the trigger are so adjusted that the pressure under piston (30) closes bleeder valve (32), and, conversely, opens the valve when the pressure has dropped the same amount. After these two single spring adjustments have been made, the compressor is ready for its regular work under the required condition of speed and pressure.

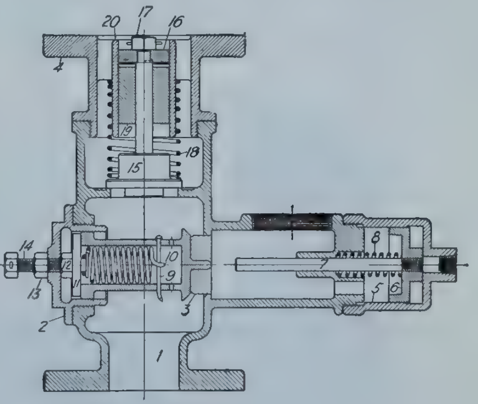


FIG. 3. STARTING UNLOADER.

The unloader in no way controls the starting and stopping of the motor. It merely unloads the compressor and keeps it unloaded until it is again started and up to required speed. The control of the motor current is accomplished by some one of the standard controlling switches and circuit breakers.

The Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa., will in the future manufacture and sell all of the Richards air-controlling devices.

Equipment Display at the Canadian National Exhibition

Staff Article

Although perhaps more so than in recent years, a bigger change in the personnel of exhibitors of machinery and general mechanical engineering equipment falls to be noted, the Machinery Hall was as usual crowded, and the various other locations and departmental sections easily maintained the reputation of former displays. Our machinery manufacturers are to be congratulated on the enterprise they have shown in fostering the country's industrial wellbeing.

THE display in the Machinery Hall at the Toronto Exhibition was quite up to the usual high standard, a fact at once gratifying to those who are interested in this section of our National Show. It was anticipated by many that the present unsettled conditions in the industrial world would adversely effect the machinery exhibits, but this fortunately was not the case. All the available space was occupied and the exhibitors showed an enthusiasm calculated to reform the most confirmed pessimist. That the majority of exhibitors are looking for good times ahead was reflected in the character of the exhibits. Many of the old familiar names were to be seen on the signs above the booths, although a number of former exhibitors were to be noted as missing on this occasion, their places had, however, been taken by others. The need for a new Machinery Hall becomes each year more apparent and most pressing, and while it is hardly to be expected that the authorities will do anything before at least another year has passed, the first favorable opportunity should be grasped. Several exhibitors complained to our representative of the roof leaking, causing thereby discomfort to those in line of the shower bath.

VIEW OF GROUNDS AND LAKE, CANADIAN NATIONAL EXHIBITION.

Among the Exhibitors.

Among the time honored exhibitors were to be seen the A. R. Williams Machinery Co. at the old stand, with their usual extensive display of tools. The Canada Machinery Corporation had the same location as last year and were exhibiting a line of new tools, among them being an all-geared head lathe and a radial drill. In the next booth was the exhibit of Corvan & Co., consisting of an interesting line of woodworking machinery. The Preston Woodworking Machinery Co. increased their space this year, and were exhibiting a number of high-class machines.

The Chapman Double Ball Bearing Co. were located in the center of the Hall and were also showing a new line this year in the form of an elevating truck for warehouses and factories. The utility of this truck is obvious after witnessing a demonstration. Close by was to be found the Dodge Mfg. Co., who were exhibiting a complete line of their well-known transmission appliances

Among the new exhibitors, perhaps the most striking was that of the Victor Saw Works, Hamilton, Ont. This company occupied a booth at the east end of the Hall and had an effective display of Victor saw blades. The various stages of manufacture were featured on a board, while other displays showed the different sizes produced, each being accompanied by a statement setting forth the particular work for which it is best suited. An interesting feature was a number of specimens of alloys used in the steel from which the saws are made. An arrangement of photographs and flags with a globe in the center illustrated graphically the world-wide use of Victor saws.

To the tired visitor, the booth of the Wilt Twist Drill Co. was especially welcome. Here some lounge chairs were provided for all those who cared to avail themselves of the opportunity, of being able to learn of the company's product under comfortable conditions. The Pratt & Whitney Co. were new exhibitors this year and showed their well-known lines of drills, reamers, etc. A booth attracting many interested visitors was that of the Carter Welding Co., who were demonstrating an Oxygraph machine. This mechanism, which is similar to a pantograph, will cut steel plates, with an oxy-acetylene flame, to any desired shape. Welding broken castings with a Davis-Bournville oxy-acetylene outfit also formed part of the exhibit.

Over the way was the booth of the L'Air Liquide Society also demonstrating the efficacy of the Oxy-Acetylene system for welding and cutting. Various samples of work done by this process showed the high standard of attainment possible, also the many kinds of work that this apparatus is capable of overtaking. The company had on view a power or hand-welding machine, also a hand welder.

An interesting machinery exhibit was that of the Canadian Fairbanks-Morse Co., in the Agricultural section. Here were to be seen stationary and marine oil engines, while in an adjoining tent was a complete 25-bag flour mill in operation. The wheat was seen being passed through the mill to make flour, and finally bread, etc., all in one tent.

Exhibitors, Exhibits and Representatives

Canadian Tool Steel Co., Toronto.—Picks, blacksmiths' tools, hammer heads, etc., made of Ductite steel; also the Dickson patent wrench. Representatives: R. I. Henderson, Fred C. Fowler.

Carter Welding Co., Toronto.—Davis-Bournville Co., oxy-acetylene welding outfits. Demonstrations with oxygraph cutting machine. Representatives: W. Carter, H. W. Carter and P. Sorley.

Canada Machinery Corporation, Ltd., Galt, Ont.—Wood working tools, consisting of chain morticer, 24-in., planer, matcher and molder; tenoning machine with cut-off saw; 12-in. molder; iron working tools consisting of a 20-in. x 10 ft. all geared head lathe; 27 in. x 16 ft., LeBlond lathe, and 4 ft. radial drill. Representatives: W. Baird, N. Blain, W. Irving, R. Dryden.

Canadian Ice Machine Co., Toronto.—Refrigerating plant in operation consisting of a 2-ton York machine, double pipe condenser, freezing tank, etc.; parts of a 4-ton York machine showing general construction. Representatives: C. E. Allison, C. H. Bower.

Canada Hart Wheel Co., Hamilton, Ont.—Complete line of abrasive wheels, razor hones, etc., and saw sharpening machine. Representative: F. S. Morrison.

Cowan & Co., Galt, Ont.—Two chain saw morticers, vertical hollow chisel morticer, 6 in., four side molder, power feed rip saw, surface planer with round cylinder grinding and jointing attachment. Representatives: W. Cowan, S. F. Barrows.

Consolidated Electric Co., Toronto.—King Edward electric motors, ½ to 25 h.p.; electric fittings, conduits, switches, etc. Representative: J. G. Howorth.

The Canadian Fairbanks-Morse Co., Toronto.—Exhibit in agricultural section of gasoline engines, direct connected pumps; various sizes of 2 and 4-cycle marine oil engines up to 25 h.p.; pneumatic water systems. Representative: R. B. Dargavel.

Climax Good Roads Machine Co., Hamilton, Ont.—Climax hand balers in two sizes for 200 and 100-pound bales respectively. Representative: H. Robinson.

Commercial Oil Co., Hamilton, Ont.—Full line of oils and greases; special transmission grease; liquid and stick belt dressing; complete line of Sharp spark plugs. Representatives: A. W. Houlding and F. C. Walsh, with J. M. Mackenney, representing the Sharp Spark Plug Co., Cleveland, Ohio.

Canada Metal Co., Toronto.—Complete line of Babbitt metal, heavy pressure bearing metal, solder, lead pipe and ingot metals, also plumbers' supply department fully equipped. Representative: W. G. Harris, W. G. Harris, Jr.

Dominion Belting Co., Hamilton, Ont.—Maple Leaf stitched cotton duck belting for power transmission and conveyors; belt dressing. Representative: J. Scott.

W. D. Beath & Son, Ltd., Toronto.—Demonstration of overhead industrial tracks and runways.—Representative: W. D. Beath.

The Canadian Morehead Mfg. Co., Woodstock, Ont.—Morehead line of steam and condenser traps. Representative: E. J. Bickle.

The Canadian General Fire Extinguisher Co., Toronto.—Automatic sprinkler fittings, steam supplies, Chapman valves, Grinnell heads, automatic sprinkler demonstration Representative: C. H. Burt.

The Dodge Mfg. Co., Toronto.—Complete line of transmission machinery, including steel and split wood pulleys, bearings, hangers, etc. Representative: J. F. Haas.

The Chapman Double Ball Bearing Co., of Canada, Toronto.—Complete line of ball bearings up to 6 7-16 in. power and hand operated efficiency testing plants. Friction clutches, thrust bearings, etc. Elevating truck for factories and warehouses. Representatives: W. J. Murray, Chas. Murray, J. B. Wilson and W. C. J Hockin.

British Aluminum Co., Toronto.—Full line of aluminum products. Representative: E. Fannell.

Cleveland Pneumatic Tool Co., Toronto.—Full line portable pneumatic drills, grinders, sand, rivetting and chipping hammers, rock drills, Bowes and Never Leak couplings, etc. Representatives: J. A. Day, C. O. Garner.

General Machinery Co., Toronto.—G. M. C. automatic water systems; demonstration of Luitweiler pumps. Representative: W. McLachlan.

Galt Foundry Co. Galt Ont.—Demonstration of the McNaughton Grate. Representative: F. W. Donaldson.

The Boiler Repair & Grate Bar Co., Toronto.—Demonstration of shaking grate. Representative: A. H. Hett.

The Elliot Woodworker, Ltd., Toronto.—Demonstration of the Elliot woodworker. Representatives: F. Elliot, G. Elliot.

The Jones & Moore Electric Co., Toronto.—Full line of Century electric motors. Representative: W. Dalton.

R. A. Lister & Co., Toronto.—Demonstration of a Lister-Bruston automatic 60-light plant and a 5 h.p. oil engine operating. In the agricultural section are a number of oil engines adapted for farm work, also Mellotte cream separators. Representative: L. Burbidge.

D. K. McLaren Co., Montreal.—British Oak Tanned Belting, D.K. Balata Belting, Philips pressed steel pulleys, D.K. wool split pulleys and general line of mill supllies. Representative: W. S. Hamilton.

J. L. Morrison & Co., Toronto.—Bookbinders' and printers' machinery. Representative: W. Doldring.

The Massey-Harris Co., Toronto.—A number of gasoline engines in operation, pumping outfits, power sprayer, etc. Representatives: B. Graham, N. A. McIntosh.

The National Equipment Co., Toronto.—Peerless automatic water systems for domestic purposes, and demonstrating a 125-gallon per hour pumping outfit; also an exhibit in the Transportation Building of the Wayne Gasoline and Oil Storage Systems. Representative: W. T. Bradley.

The Nash Temperature Control, Ltd., Toronto.—Nash automatic controlling devices for ings. Representative: J. M. Watson.

The Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.—Display of indicating and recording gauges, indicators, tachometers, pyrometers, etc. Representative: Curt E. Georgi.

The H. Mueller Mfg. Co., Sarnia, Ont.—A full line of waterworks brass goods, including the Mueller under-water drilling and tapping machine.

The Ontario Wind & Engine Co. Toronto—Various sizes, of Chapman gasoline engines, portable and stationary, in operation.

The James Morrison Brass Mfg. Co., Toronto.—An interesting line of brass goods for engineers, including valves, fittings, gauges, injectors, whistles, etc. The exhibit occupied considerable space and was arranged in a highly attractive manner.

The Northern Electric & Mfg. Co., Montreal.—Exhibit in the Industrial Building, consisting of samples of wire and cable, lamps, telephones, fire-alarms, telephones, switchboards, etc.

The L'Air Liquide Society, Toronto.—Demonstrating oxy-acetylene welding; hand or power welding machine for boilers, tanks, etc.; hand welding machine for light work, acetylene generators and numerous specimens of work. Representatives: J. Macmillan, T. Girouard, G. Cooper.

The Pratt & Whitney Co., Dundas, Ont.—Display of P. & W. twist drills, reamers, taps, dies, and milling cutters; also a 10 in. tool maker's lathe. Representatives: J. D. Dixon, H. Webb.

Preston Woodworking Machine Co., Preston, Ont.—Belt sander, power feed saw, 12 in. molder, 36 in., band saw, 24 in. panel planer, 36 in. high speed ball bearing shaper and Newport attachment for molding machines. Representatives: W. J. Murray, W. E. Near.

The Siche Gas Co., Toronto.—Oxy-acetylene welding and cutting plants, Siche gas for lighting, Oxyweld for welding, Allan-Liversidge acetylene generators for automobiles, etc., acetylene heaters and stoves. Representative: L. R. Arnett.

The Victor Saw Works, Ltd., Hamilton.—Victor hand frame and power hack saw blades. Display of saw blades showing different stages in manufacturing, and alloys used in making saws; rail cutting frame with clamps. Representatives: C. O. Jackman, W. S. Pollock.

Wilt Twist Drill Co., Walkerville, Ont.—Complete exhibit of Wilt twist drills and reamers. Representatives: W. A. Tingle, H. K. Clark.

The Holden Co., Montreal.—Complete line of portable electric and air tools, rock drills, and railway supplies. Representative: J. B. Wilson.

The Garloch Packing Co., Hamilton.—Full line of Garloch packings and Keystone grease. Representative: N. G. Davis.

The Arnold Co., Toronto.—The Arnold Automatic Fuel Economizer.

Baines & Peckover, Toronto.—Line of Saville's tool steel, Triumph Superb; crucible, vanadium and cold rolled steel; expanded metal, babbitt metal, chain, wire rope, etc. Representatives: W. M. David, T. A. Steven, H. W. Marshall, A. McGregor, W. P. Williams.

Cling Surface, Buffalo, N.Y.—Belt treatment, demonstration showing high efficiency of slack belts with Cling Surface. Representative: J. J. B. Faatz.

S. F. Bowser & Co., Inc., Toronto.—Exhibit in Transportation Building: Gasoline and lubricating oil systems, Red Sentry pump for automobile, curb filling stations. Process Building: Lubricating oil systems, filtering systems, etc. Representatives: R. W. Williams, A. McIntosh, A. E. Moffatt, E. T. Murphy, and H. T. Stern.

Belt Grip Pulley Co., Buffalo, N.Y.—Leather-faced pulleys for high-speed drives, leather castors. Representatives: A. E. Finch, C. G. Hurlburt.

H. F. McIntosh & Co., Toronto.—Sales agents for Star expansion bolts. Representatives: M. McIntosh, W. J. Stacey.

J. J. Martindale, Toronto.—Demonstration of the Tuec stationary vacuum cleaner for office buildings, residences, hotels, etc.

The Prest-o-Lite Co., Inc., Toronto.—Prest-o-Lite for automobiles, motor boats, etc.; compressed acetylene for lighting, welding, etc. Representative: H. R. Weckerle.

Mackintosh Hutchinson, Toronto.—Demonstration of the Hutchinson portable combination woodworker with dado, ripping, crosscut and boring attachments in two sizes, with 1½ h.p. and 3 h.p. motors respectively. Representatives: M. Hutchinson, H. Trevett.

The Positive Clutch & Pulley Co., Toronto.—Demonstrating the positive combined jaw and friction clutch, heavy duty combination pulley, all-steel pulley and wood split pulley; gas engine friction clutch. Representative: R. A. Fraser.

A. R. Williams Machinery Co., Toronto.—Le Blond 17 x 8 heavy duty lathe, Barnes 24-in. drill, Harper planer, Famous woodworker, Drummond foot-power lathe, Warner & Swasey universal turret lathe, Brown & Boggs press, Perfect emery grinder, Morris 1-ton worm gear chain block, Lennox throatless shear, Evinrude gasoline engines. Representatives: T. Reid, E. C. Cronk.

Personal

G. T. Bell, passenger traffic manager of the G.T.R., was the recipient of many congratulations upon the anniversary of his birthday. Mr. Bell having been born in Montreal on September 7, 1861.

Ellson Fawkes, waterworks engineer, Calgary, will retain his position until certain sections of the work have been completed.

A. N. Beer, who has been engineer in charge of the Waterworks Department of the City of Ottawa during the past year, has resigned.

J. H. Clark, a member of the staff of R. E. Speakman, city engineer, has been appointed purchasing agent for Brandon. Man.

Willis Chipman, C.E., of Chipman & Power, consulting engineers, Toronto, has been retained by the City of Edmonton to report upon the several electric power schemes now under consideration.

Fritz Girkel, consulting mining engineer, died in Montreal on August 24. Mr. Girkel was at one time consulting engineer for a syndicate operating in the Bridge River gold region in British Columbia.

R. L. Dobbin has been appointed water-works superintendent for the Peterborough Utilities Commission, Peterborough, Ont. Mr. Dobbin was formerly resident engineer on the Moose Jaw water supply.

J. W. Radcliffe, of the British-Canadian Engineering Co., Winnipeg, has been visiting Grenville and Broadview, Sask., where the company are installing electric lighting plants.

G. Gordon Gale for many years general superintendent of the Hull Electric Co., has recently been appointed general manager. Mr. Gale is a graduate of McGill University and has had valuable experience both in operation and management. Prior to 1907 he was assistant engineer of the electric plant of the Canadian Rubber Co. In that year he become associated with the Hull Electric Co. and has filled successfully the positions of superintendent of power, acting superintendent, and, for the last five years, general superintendent.

Robert Bewick Longridge, M.I., Mech. E., who died recently at his home, Over Tabley, Cheshire, England, in his ninety-fourth year, was the pioneer of boiler insurance, and probably the oldest member of the Institution of Mechanical Engineers. He was educated at Edinburgh University, and afterwards was the head of the locomotive department at the Bedlington Ironworks. As long ago as 1854 he was appointed chief inspector of the Manchester Steam Users' Association. In 1859 he started the business of the Boiler Insurance and Steam Power Co., now the Vulcan Boiler Insurance Co. In 1878 he left to take the control of the Engine, Boiler & Employers' Liability Co., now the British Engine, Boiler and Electrical Insurance Co., of which he was for many years the chairman. It is interesting to recall that within twelve months of the constitution of the Manchester Steam Users' Association, Mr. Longridge issued the first set of instructions to firemen, which throws a strong light on the views held fifty years ago on the safety of boilers. They were as follows:—"In throwing on fresh coals, spread them evenly over the bars, commencing at the bridge end. Large coals should be broken into pieces not larger than a man's hand. Never allow any part of the grate surface to be uncovered, nor allow the fire to burn too low. There should be not less than 4 in. thickness of bright fuel on the bars when a fresh charge is thrown on. Keep the fire-bars free from clinkers. In case of the water falling below the bottom of the gauge glass, draw the fires at once; but if the plates of the furnace should have become red hot before this has been noticed and the fires cannot be drawn with safety, at all events close the damper, but on no account let water into the boiler. In such cases, if the engine be not at work, it must not be started, nor must the safety valve or any other valve be opened. In short, the boiler must be left undisturbed until it has gradually cooled down." The fear of the myth concerning the terrible power of the spheroidal condition of water then overshadowed all other dangers, and Mr. Longridge seems to have been a believer in the theory, for he induced the Committee of his Association to sanction the construction of a model boiler with which to demonstrate the truth of the theory. The vessel was 3 ft. long and 18 in. diameter, provided with water and pressure gauges and thermometer. The fire was placed on one side, so that the steam space plates and under-water plates became heated. Super-heating of the steam occurred, but a fall of both pressure and temperature resulted each time that the water was agitated. The only mishaps which occurred were the fracturing of thermometer bulbs. Mr. Harman—Mr. Longridge's successor as chief engineer to the Steam Users' Association in 1859—appears to have grasped the fact that the latent power for mischief was not so much in the steam, as in the water of a boiler, and that therefore not only the pressure, but also the volume of a boiler should be regarded as measures of its destructive power. The chief engineer of the British Engine, Boiler & Electrical Insurance Co. is now, of course, Michael Longridge, M. Inst. C.E., a nephew, and the managing director is Charles Longridge, a son of the founder.—The Engineer.

Trade Gossip

E. Laurie & Co., Montreal, have sold a motor driven turbine pump to the town of Lachine, Que. The outfit will cost $3,900.

The Harland Engineering Co., power engineers and contractors, have removed from 26 Victoria Square to larger offices at 102 St. Antoine Street, Montreal.

Edmonds, B.C.—The town has awarded to the Robertson-Godson Co., Vancouver, B.C., a contract for the supply of 10,000 feet of 4-inch main, the pipe supplied being manufactured by the Page-Hersey Co.

The Turbine Equipment Co., Toronto, has been awarded a contract, by the Toronto Board of Control, for two 24 million gallon pumps for the main pumping station. The price of the first unit is $50,400 and of the second $48,400.

Brockville, Ont.—The Warwick & Walters, Co., of Montreal, makers of gas and oil engines and accessories, are contemplating establishing a plant here. The company propose to rent an existing building and equip same with the necessary machinery.

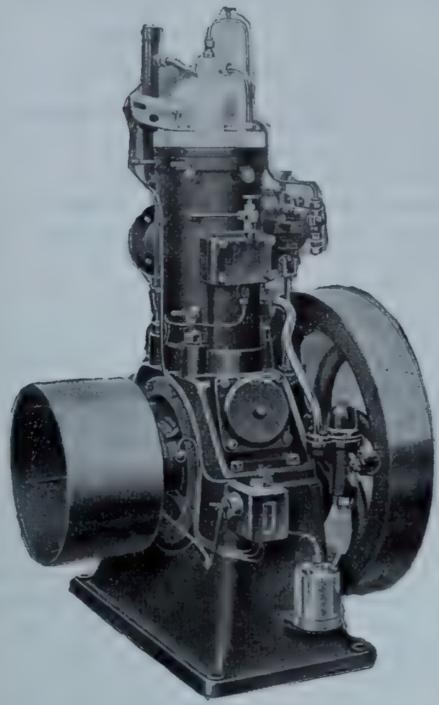
The Hare Engineering Co., Toronto, have appointed as their Manitoba and Saskatchewan representatives, Refrigeration and Engineering Co., 700 Portage Avenue, Winnipeg, Man., to whom all inquiries arising in Manitoba and Saskatchewan should be addressed.

The Hare Engineering Co., Ltd., Toronto, have secured the Canadian Agency for the Bulkley Barometric Condenser, from the M. W. Kellogg Co., New York, who have arranged to push this condenser by means of its various local agencies.

Prince Albert, Sask.—The following contracts have been awarded in connection with the extensions to the waterworks: Cast iron pipe, Can. Allis-Chalmers, Ltd., $18,324.56; special castings, U. S. Cast Iron Pipe Co., of Burlington, N. J., 4,232 tons, at $42.50 per ton; valves and hydrants, Kerr Engine Co., Walkerville, Ont., $2,716.30.

The Elliott Company, Pittsburgh, Pa., has appointed George Gray, of Boston, Mass., Sales Manager for the New England district. Mr. Gray is well known in the New England territory, and was connected with the Elliott Company's interests several years ago. The office of

MUNKTELL
CRUDE OIL ENGINES



Economical in working and upkeep. Simple in construction and requires minimum attention. Workmanship and material of the highest order.

Built in Canada in a modern shop under the supervision of a well-known expert and authority on oil and gas engines.

Prices moderate.

Write for fully illustrated booklet and information.

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CANADIAN ASSOCIATION
OF
STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

A. KASTELLA
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Super-Dreadnaught "RIVADAVIA"—latest addition to the Argentine Navy.

In Times of War

the fate of a nation may depend on the satisfactory operation of the machinery. Naval Authorities choose only apparatus that is tried, tested and proven—apparatus that runs without the necessity of constant attention — apparatus that will not break down at the critical moment.

105 Sturtevant
Fans and Forced Draft Equipments

supply this super-dreadnaught with air. Forced draft fans supply 480,000 cu. ft. of air per minute.—Should any of these fans fail the steaming power and consequently the speed of the ship would be greatly reduced.—Dependable apparatus is essential. — That's why it's Sturtevant.

Besides Forced Draft this ship has over 80 Sturtevant Ventilating Fans and over 20 Ready-to-Run Portable Ventilating Sets for supplying air to cabins and smaller rooms.

Consult the largest body of trained fan engineers in the world. A postal is enough.

B. F. Sturtevant Company
Hyde Park, Boston, Mass.
and all principal cities of the world.

the company will remain at 954 Oliver Building, Boston, as heretofore.

The Elliott Company, Pittsburg, Pa., has appointed William A. Day, to be Chicago district sales manger. Mr. Day was formerly sales manager of the Erie City Iron Works in the Chicago district, and is well known both as a salesman and as an engineer. The Elliott Company's Chicago office will be as heretofore, at 527 Monadnock Block.

The Siemens Co. of Canada, Ltd., Montreal, P.Q., has been awarded the contract by the Dominion Government for the supply of submarine cables—23 knots of single conductor submarine telegraph cable (107 lbs. copper and 150 lbs. gutta-percha per knot), with sheathing of 12 No. 8 s.w.g. iron wires, to be delivered at Halifax, N.S.; and 14 knots of the same to be delivered at Vancouver, B.C.

Pump Orders.—The Smart-Turner Machine Co., Hamilton, Ont., have recently closed the following orders for pumps:—The Cobalt Lake Mining Co., Cobalt, Ont., one centrifugal pump; the Deloro Mining & Reduction Co., Deloro, Ont., one centrifugal pump; the Canadian Porcelain Co., Hamilton, Ont., one centrifugal pump; the M. & M. A. Deans Co., Sprucedale, Ont., one duplex steam pump.

The Hare Engineering Co., Toronto, manufacturers of mechanical stokers, report a considerable increase of business during the month of August. They secured a number of contracts, among which are the Seminaire de Rimouski, Rimouski, Que.; College de L'Assomption, L'Assomptionville, Que.; Canadian Pacific Railway, Glen Yards Shops, Montreal; Chipman-Bolton Knitting Co., Hamilton, Ont.; Fulton water cooled mechanical stokers will be installed in each case.

Fraser & Chalmers, of Canada, Ltd., Montreal, have received an order from the Siemens Co., of Canada, for one-188 h. p. Terry steam turbine, running at 3600 r.p.m., fitted with "**Falk**" gearing, for reducing the speed to 1200 r.p.m., so as to be suitable for direct coupling to a Siemens excited generator. This machinery will be installed by the Corporation of the City of Regina.

Kerr Engine Co. Fire.—The Kerr Engine Co., Walkerville, Ont., desire to assure their numerous customers and the trade generally that, in the recent fire at their plant, nothing was lost or damaged to in any way interfere with their filling orders for brass or iron valves and hydrants, or any of the lines listed or shown in their catalogue No. 5, recently issued. Such patterns as were lost were of engines, pumps and mill machinery.

The Canadian Crocker-Wheeler Co., St. Catharines, Ont., advise us that owing to present unsettled conditions, the rapid increase in the cost of most raw materials, and the uncertainty of all sources of supply, they find it necessary to withdraw all outstanding quotations and to advise customers that prices previously in force are hereby canceled. Orders will be accepted at prices agreed upon or on the understanding that goods will be billed at prices ruling at the date of shipment. Although meantime impossible to foresee what the trend of prices may be in the future, all customers are assured that the company will serve them to the best of their ability as heretofore.

The Canadian Westinghouse Co., Hamilton, Ont., give notice that on account of present unsettled condition of business throughout the Dominion, they are compelled to notify customers that all outstanding prices and quotations on electrical apparatus and supplies unaccepted as at August 14 are hereby withdrawn. The necessity of this course is regretted, but that it is unavoidable, follows from existing financial conditions disturbed by the general European war, from the large increase in prices already registered in several lines of raw materials, and from the uncertainty as to a continuance of supply of various other elements of manufacture consequent on interruption of international commerce.

An early improvement is hoped for on all points, and meanwhile the company will be glad to furnish quotations upon request at lowest figures permissible under the current conditions.

The Canadian Tungsten Lamp Co., of Hamilton, Ont., has felt the effects of the war in a beneficial manner. Many companies which secured most of their lamps from Germany have been forced to place their orders with the local concern, and sufficient orders to keep the plant running at a fair rate have been received. W. H. Ginder, manager of the plant, stated that, while the company had been able to secure trade which otherwise would have been given to German firms, it was facing a difficulty in that all of the platinum used in the manufacture of the lamps comes from Russia, and it is difficult to secure an adequate supply. The company has sufficient platinum to last a few months, and Mr. Ginder is hopeful that in the meantime further shipments will be received. The company is endeavoring to keep all of its men employed, and denies that a cut has been made. Owing to the difficulty in securing raw materials, the lamps will cost more, and a new price list is being issued.

Catalogues

Belt Lacing.—Alligator steel lacing for machinery belting is the subject of a booklet being issued by the Flexible Steel Lacing Co., Chicago, Ill. A full description is given of the lacing and method of application. Several sizes are illustrated, and prices and particulars given regarding the work for which each is best suited.

Steam Traps.—The Flinn Steam Trap, made by Richard J. Flinn, West Roxbury, Mass., is fully described in a leaflet just to hand. The principal constructional features and method of operation are dealt with fully, while a table is included giving the capacity of each size of trap. The illustrations show sectional and external views.

Accumulators.—Bulletin "Section A" issued by Canadian General Electric Co., Toronto, describes the Electric Storage Battery Co.'s chloride and Tudor accumulators for electric railway service, central lighting and power stations, isolated lighting and power plants, interlocking switch and signal service, telephone, telegraph, fire alarm, laboratory and small motor work.

Ash Hoists. — The Herbert Morris Crane & Hoist Co., Toronto, have issued bulletin 2-13, describing the **Morris** telescopic ash hoist. This hoist was designed primarily for use in basements having trap doors in the sidewalks, and the method of application can be readily seen from the illustrations in the bulletin. The hoist is suitable for domestic or factory purposes.

Badger Engines for gas, gasoline, or kerosene, Catalogue No. 13, issued by the Canadian Allis-Chalmers, Ltd., Toronto, describes fully the engines built by the Christensen Engineering Co., Milwaukee, Wis., which are specially adapted to furnishing power in blacksmith and machine shops. They are made in sizes from 2½ h.p. to 30 h.p. The illustrations show the various types and are accompanied by tables giving the essential particulars.

Conveyors.—The New Conveyor Company, Ltd., Smethwick, Birmingham, England, have sent us a catalogue dealing with elevators which they make for all purposes. The illustrations are very clear and show numerous installations of conveyors working under varying conditions, indicating the wide range of work capable of being performed by them. Other illustrations show screw conveyors, detachable chains, etc. Each illustration is accompanied by a brief description.

Crude Oil Engines.—Special catalogue No. 5 has been sent us by the Oil Motor

Liberty Boiler Tube Cleaners

will keep your boilers clear and free from scale, and are the very cheapest insurance against Accidents.

A LARGE majority of boiler explosions are caused by an accumulation of scale. The scale coating prevents the water from reaching the iron, and the intense heat soon burns out the tube.

Besides eliminating the danger of accidents, there is the fuel saving which will in a short time repay the cost of a LIBERTY CLEANER.

Ask any of your friends that have used our Cleaners what they think of them. If you write us, we will give the name of a user of our Cleaners in your own City or vicinity.

Write for Catalogue "H" which will tell you about our different types of Cleaners for all kinds of water or fire tube boilers.

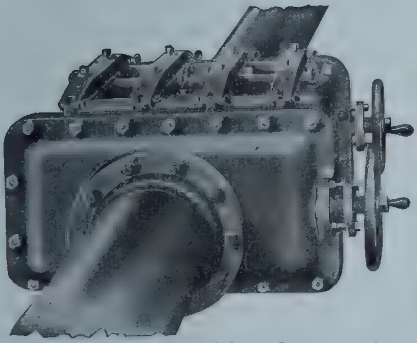
Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

Let the ELLIOTT TWINS Do It

The only DIRECT FLOW Strainer built that gives continuous service.



Horizontal position, doors on top.

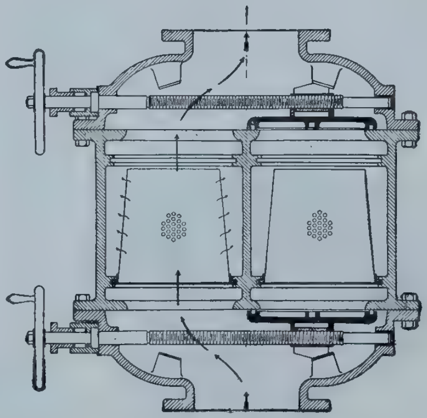
Do your condenser tubes become clogged with rubbish?

Do your pump valves get stopped up, cut out, need constant attention?

Do you have trouble with any of your water handling machinery, on account of the leaves, sticks, grass, etc., in your service water?

The TWIN STRAINER is the best remedy for such troubles. The thousands of them in use to-day is the best evidence we have of their satisfactory service.

DESIGNED TO PROTECT—BUILT TO LAST.
Our Bulletin No. A is yours for the asking.



Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

ELLIOTT COMPANY

6902 Susquehanna Street, **PITTSBURGH, PA.**

Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

DIXON'S
Solid Belt Dressing

Simply rubbing these handy sticks on your belt while it is running will restore its life and flexibility—give it a surface that grips the pulleys the way you want your belt to—makes your belt last longer — saves power and belting. Send for Booklet No. 222, "The Proper Care of Belts."

Made in Jersey City, N.J., by the
JOSEPH DIXON CRUCIBLE CO.
Established 1827.

THE BAR-KEEPER'S FRIEND

Best known Metal Polish. Guaranteed forever. Largest sale in the World.

Model A, $1.10 per inch.

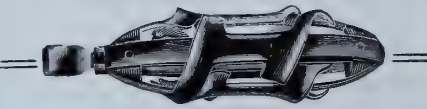
THOMAS' IDEAL FLUE CLEANER

Patent 1911

Has cutting edges of chisel shearing shape on both ends, which shave flue as clean as day it was made. Adjustable to wear—easily sharpened—strongly built. Made to do the work.
The IDEAL is the most perfect cleaner on the market to-day.
Sold on guarantee from your dealer or direct from manufacturer.

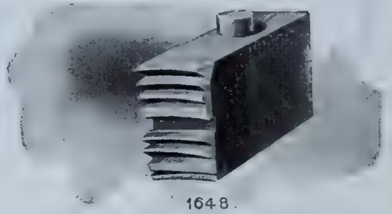
Manufactured by
S. I. THOMAS, 6 Afton Ave.
Toronto, Can.

Model B, $1.00 per inch.



"Premier" Die Stocks

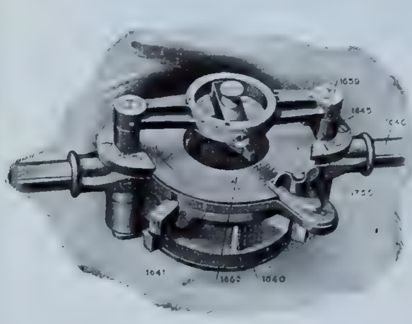
THEIR ADVANTAGES lie in the fact that they thread all sizes of pipe without changing dies; are adjustable, and are built on an easy working (receding die) principle, which positively enables one man to thread any size of pipe, and produces absolutely tight joints for all work, including hot water, and will cut lock nut threads, all of which they do without the aid of a leader screw, and automatically release, instead of backing off, which spoils the dies.



Two Dies in One

The off-set die enables you to accomplish by going over pipe once, what any other make would do in going over twice.

Write for full particulars.



Die Stock Open

Borden-Canadian Co.
66 Richmond St. E., Toronto, Ont.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

& Mfg. Co., St. John, N.B. This catalogue describes fully the **Munktell** crude oil engines which are made in horizontal and vertical stationary types and also portable type. A general description covering the design of the engine is given together with tables giving the principal dimensions and other particulars. Illustrations of each type are included together with figured diagrams for use with the tables.

Motor Driven Pumps made by the Canadian Westinghouse Co., Hamilton, Ont., are described fully in catalogue 3002-A, section 3032, recently issued. The advantages of the motor drive for pumping installations is dealt with from various viewpoints with special reference to Canadian Westinghouse motors and their suitability for this work under varying conditions. Several views showing installations are included while the concluding pages contain some useful pumping data and tables.

Strainers.—The Lagonda Mfg. Co., Springfield, Ohio, has just published a complete 20-page catalog descriptive of their multiple water strainers for power plant and pumping station intake lines. These strainers are of the multiple straining basket type, which can be easily and quickly cleaned without interruption to the flow of water. Other Lagonda products, such as boiler tube cleaners, automatic cut-off valves, reseating machines and tube cutters are also described and illustrated. The new catalog is entitled the Lagonda Multiple Strainer, edition R-2, and will be sent upon request.

The Lufkin Rule Co. of Canada, Ltd., Windsor, Ont., announce the issuing of their new catalog, No. 9, now ready for distribution. Its 110 pages are devoted exclusively to measuring tapes and rules, making it unquestionably a most complete catalogue of such goods. The various items throughout the book are well arranged, and most comprehensively presented. The embossed cover is of strikingly original design, executed in the Lufkin stock label and box colors, tan and maroon. In the catalogue, the special attention of the trade is invited to the fact that in addition to measuring tapes, steel rules, etc., the company now manufacture a complete line of folding boxwood and flexible spring joint wood rules, and carries a full stock of both, enabling them to make prompt shipments. All requests for copies of the new catalogue will receive prompt attention.

The Keith Fan.—A catalogue, No. 55, of particular merit has just been issued by Sheldons Ltd., Galt, Ont., makers of the **Keith Fan.** The idea in compiling this catalogue is to point out a few salient points wherein the Keith fan differs from other multiblade wheels, and to give architects, engineers and operators, exact information and data concerning the performance of the fan together with dimensions of the various arrangements included in the standard designs. The catalogue contains numerous tables of capacities giving the results of exhaustive tests made on the fans under actual operating conditions and are dependable for the speeds and pressures shown. Each table is accompanied by diagrams figured to correspond with the tables. Other illustrations show various types of fans and blowers, while the concluding pages contain information regarding heating coils, engines, exhausters and the "Eclipse" air washer. A novel feature which attracts the eye is the double cover; the outside front cover showing an exterior view of the fan casing, while the inner front cover shows an interior view of the casing with fan.

Book Reviews

The Young Man and the Electrical Industry is the title of a story written by James H. Collins, the well-known magazine writer, which has just been issued by the Westinghouse Electric & Mfg. Company. The little books deals with the opportunities afforded a young man in this industry and the different lines in which he may direct his activities as exemplified by the works of the Westinghouse Electric Co., who announce that they will supply a copy to anyone interested in the development of young men.

The Log Book of the Power Plant is the title of a book published by the Yarnall-Waring Co., Philadelphia, Pa., and deals principally with the Lea Notch Liquid Recording Meter. This book might well be called a treatise on metering feed water for it contains much valuable information on the subject, although with special reference to the Lea apparatus. Among the principal contents of the book are the following subjects:—The value of a recording hot water meter; advantages of measuring boiler feed and condensate; the various methods of water measurement; the inherent advantages and applications of the Lea V-Notch Meter; authentic tests by well-known engineers, with data obtained. In addition to the above, several tables are included, giving capacities, dimensions and shipping weights of various types of Lea meters, accompanied by diagrams. The book contains 88 pages and numerous illustrations, diagrams and charts covering the various types of meters together with many installations, etc. It is printed in bold, clear type, and indexed.

Classified Advertisements

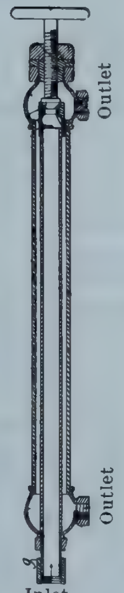
Those who wish to sell or buy a business, obtain competent help, connect with satisfactory positions or secure aid in starting new enterprises, should not fail to use the Want Ad. Page of The Power House.

WANTED

WANTED, FIRM WITH CONNECTION among steam users to take up sole agency for old-established Metallic Engine Packing. Box 118, "The Power House," 88 Fleet Street, London, England.

FOR SALE

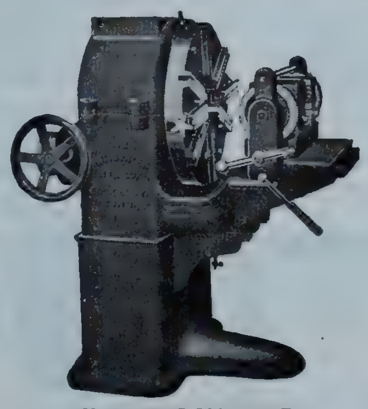
ENGINE FOR SALE—ONE 65 H. P. NASH 3 cylinder gas engine direct connected to 40 k.w. Fine shape. Guaranteed. With switchboard. Good for picture theatre or garage. Will sell on time. The Meriam Co., Cleveland, O. (10)



THE LONG (Patent)
STEAM TRAP

Regulated to work against any pressure between 1 and 200 lbs., and is capable of draining from 900 to 1,500 feet of 1-inch pipe. Works automatically. No valves except those which control the admission of steam to the apparatus to which the trap is attached. Starts when steam appears. Being open at starting, **cannot become air bound, thus doing away with air cocks or vents.** Can be installed in any position, and **will never freeze** if set so as to drain when leaving at night. You need it.
Write for full particulars.

J. T. LONG
69 4th Ave., Maisonneuve
MONTREAL, QUE.



No. 3 PIPE MACHINE
THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES
A Very Desirable Machine for
PLUMBERS and STEAM FITTERS
Manufactured by
THE ARMSTRONG MFG. CO.
298 KNOWLTON ST.
BRIDGEPORT, CONN.
Write for Catalog
NEW YORK **CHICAGO**

Daum's Plastic Metallic Packing

ALL SIZES IN ONE CAN
For Every Purpose

Just Pack It Tight
That's All

RESULT:

- *Perfect Lubrication*
- *No Scored Rods*
- *No Steam Too Hot*
- *No Pressure Too High*
- *No Cutting*
- *No Shaping*
- *No Waste Ends or Dried-Out Packing*
- *Will Not Burn Out or Bind the Rod*

WE GUARANTEE
that Daum's Plastic Metallic Packing will outwear, several times over, any fibrous packing on the market, and will keep rods in excellent condition.

Any failing to be as represented will be returned to us at our expense, and money will be refunded without argument.

Before securing the exclusive selling rights for this packing, we assured ourselves of its merit, and we recommend it to the Engine with absolute confidence that it is all that we represent it to be.

Put up in 3-lb., 6-lb. and 10-lb.
Tins at $1.50 per lb.

W. W. CARRUTHERS
Sole Distributors
WINNIPEG, MAN.

HINTS TO BUYERS

LUBRICATING

Canadian Oil Companies, Limited

TORONTO MONTREAL ST. JOHN
HALIFAX WINNIPEG
REGINA CALGARY
NELSON

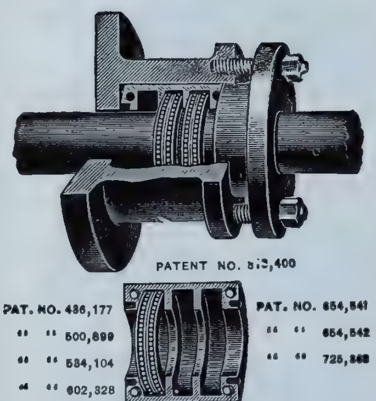
OILS

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

HON. J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto



Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

HIGH-GRADE OILS

Lubriko V Russian Gas Engine Oil — Will run your large gas engine perfectly when all other oils fail.

Lubriko Y Russian Gas Engine Oil has very low cold test, good viscosity, no carbon; specially suitable for silent Knight engines.

Lubriko Russian Ammonia Oil is specially adapted for use in ammonia and ice machine plants, giving perfect lubrication at a very low degree of temperature.

Lubriko Russian Electric Motor Oil is the one motor oil suitable for use in all climates, and will in no way gum the motor.

Lubriko Russian Engine Oil is the highest grade engine oil produced.

Lubriko Russian Stainless Oil is used in knitting and white goods plants, where an absolutely stainless oil is required.

Lubriko Russian Air Compressor Oil will prove its merit in every test.

We also carry many other lines of high-grade oils.

Try our **Lubriko Cup Grease**, the highest melting point cup grease in the world. Also our Emulsive Lard Cutting Oil.

Commercial Oil Co., Ltd., Hamilton, Ont.

COAL

The freight and duty is the same on **high-grade coal** as on medium or low-grade coal.

Our **Lone Star** slack coal is guaranteed to show 14,000 B.T.U.'s regularly.

Our specialty in Canada is high-grade coal from Kentucky and West Virginia via Detroit.

Let us have your inquiries, and call on us if in need of **prompt shipment** via Buffalo, Car Ferry or Detroit.

Ohio & Michigan Coal Co., Detroit, Mich.

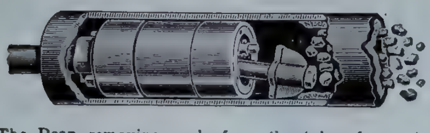
Dominion Coal Co. Ltd.

DOMINION COAL COMPANY LIMITED

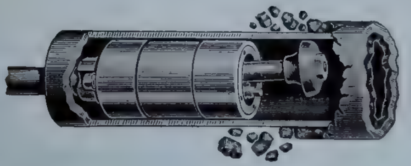
"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE
112 St. James St. Montreal

The advertiser would like to know where you saw his advertisement—tell him.



The Dean removing scale from the tube of a water-tube boiler.



The Dean removing scale from the tube of a return-tubular boiler.

The Dean Boiler Tube Cleaner can help you to get more power, burn less coal and have fewer leaky and burned out tubes

When you let the DEAN take care of your scale troubles it will do all these things for you. Will you let us tell you all about the DEAN way of removing scale and who use it in Canada? Write for "Scale Removal Made Easy."

THE WM. B. PIERCE CO.

153 Ellicott St.
BUFFALO, N.Y.

201-2 Coristine Bldg.
MONTREAL, CANADA

ELMIRA

POWER TRANSMISSION MACHINERY

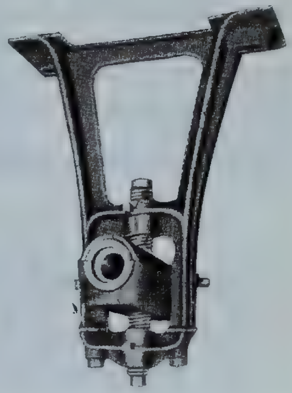
assures highly satisfactory service because it is well made from high-grade materials by men of wide experience.

UNIVERSAL DROP HANGERS

have self-oiling bearings and when once filled with oil will run six months without re-filling.

The oil is drawn to the shaft by means of tempered steel rings and woven cotton wick. Easily lined up because of its adjustment in every direction.

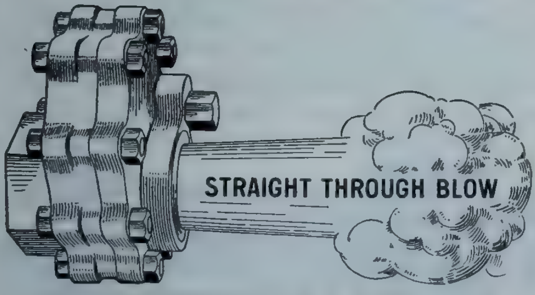
ELMIRA MACHINERY & TRANSMISSION CO., Limited
ELMIRA, CANADA



EVERLASTING

BLOW-OFF VALVES

200,000 IN USE



IT NEVER LEAKS!
WRITE FOR PRICES

Does your Boiler leak, Mr. Engineer?
How often do you blow it?
The "EVERLASTING" is the only perfect blow-off valve on the market.
No stuffing box—requires no packing—is self-cleaning, and has a self-grinding seat—nothing to get out of order—What's the answer?

RELIABILITY—SIMPLICITY.

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St. West, TORONTO
LIMITED

AGENTS

MONTREAL, QUE.
H. L. Peiler & Co.

CALGARY, ALTA.
P. D. McLaren Limited

VANCOUVER, B.C.
Taylor-Forbes Company, Limited

WINNIPEG, MAN.
The A. R. Williams Mach. Co.

"EVERLASTING" Blow-Off Valves are registered and approved of by the following Provincial Governments:—ONTARIO, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA.

WHY USE OIL

When GREASE Gives More Uniform Lubrication, Is Better and Much Cheaper?

This Grease Cup will pay for itself many times over with the money it saves in lubricants.

You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

The efficiency of this Grease Cup cannot be affected by centrifugal force when used on loose pulleys.

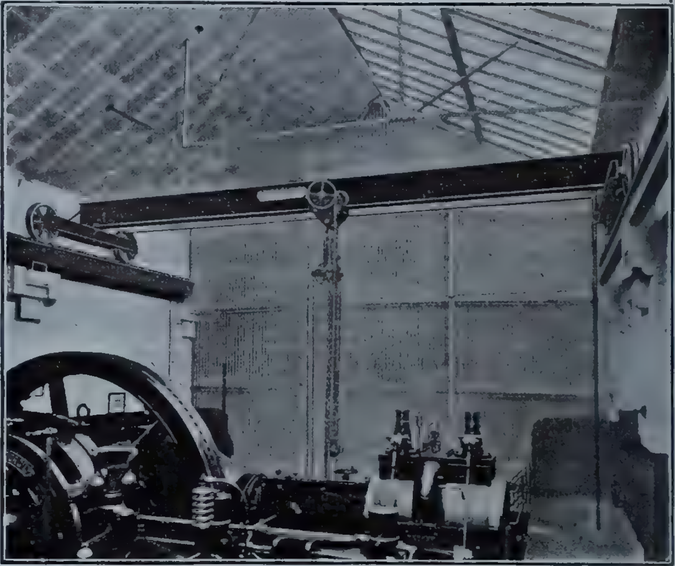
REMEMBER we guarantee it to save 50% over any other system.

Give it a trial and be convinced.

Write for particulars.

Peterborough Machine and Lubricator Co., Limited
Peterborough, Ontario

MORRIS CRANES ARE SAFE, LIGHT, FAST, AND EASY. WE STOCK ALL SIZES.



THE HERBERT MORRIS CRANE & HOIST COMPANY, Limited.
EMPRESS WORKS, PETER STREET, TORONTO.

Do You Know Your Engine Speed?

Are you getting best results from your engine, or motors, or from any of the machinery for which you are responsible? Or, on the other hand, are you overspeeding some of these machines, and wearing them out too soon, without knowing it?

The accurate, simple way is to use a

Starrett Speed Indicator

It will indicate highest speed without heating. You can use it on engines, motors, shafting, grinders, or any kind of machinery, and you'll know you're right if you go by what it says. If the light is poor you don't need to watch the dial, for the knob on the revolving disc passes under the thumb at every hundred revolutions.

Rubber tips for pointed or centered shafts prevent slipping. Costs only a dollar. Your hardware dealer will be glad to show you one.

Send for catalog No. 20 C. D.

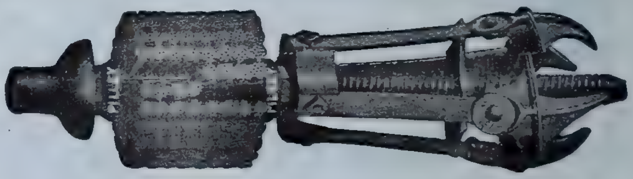
THE L. S. STARRETT CO.
ATHOL, MASS.

42-12

PILLEY

Combination Flue Brush and Scraper

The adjustable scraper, made in sizes to fit any tube from 2-in. to 6 in., loosens all scale and soot and the steel brush removes it thoroughly. Will not injure the tubes in any way, but cleans *clean*. Built substantially.



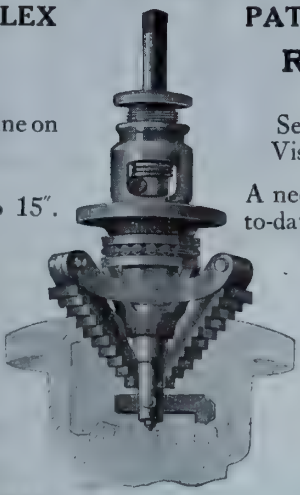
Makes Clean Flues and Keeps Them Clean

Nothing to get out of order. Brush wires guaranteed not to break or pull out. Wire brush can be renewed at small cost.

Pilley Packing & Flue Brush Mfg. Co.
611 S. Third Street -:- St. Louis, Mo.

SIMPLEX SPECIALTIES

SIMPLEX VALVE **PATENT RESEATER**



Simplest Machine on Market.

All Sizes up to 15".

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Self-Centering Visible Cutters

A necessity in an up-to-date Power Plant.

Faces Valves with Flat or Angled Seats

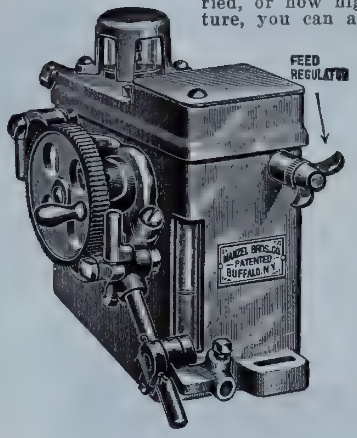
SIMPLEX No. 2 SELF-ADJUSTING FLUE CLEANER

GEO. H. TOD	TORONTO
GEO. H. TOD CO.	WINNIPEG
WESTERN SUPPLY & EQUIPMENT CO., Ltd.	CALGARY
W. POOLE DRYER CO., Ltd.	VANCOUVER
MAYSMITH & LOWE Ltd.	VICTORIA

BROMELL PATENTS CO., Ltd., Glasgow, Scotland

Manzel Oil Pumps

will give you efficient lubrication at A 50 PER CENT. SAVING IN OIL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MANZEL BROS. CO.
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We stand ready to send one on 30 days' trial. If it is not highly satisfactory, return it at our expense.

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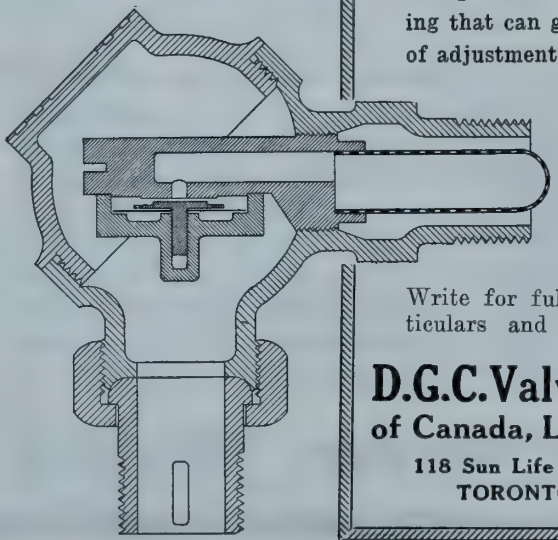

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CANADIAN MADE

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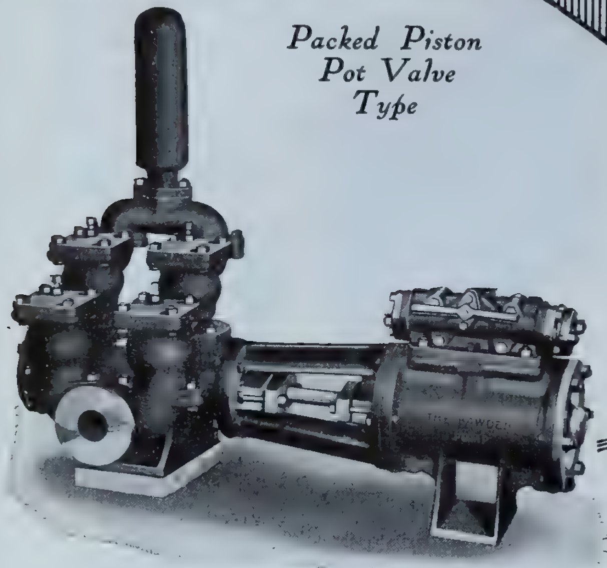


Packed Piston Pot Valve Type

No Tappets, No External Valve Gear Levers or Springs, No Internal Tubes or Stuffing Glands.

THE STEAM CYLINDERS

The **"Bawden"** is governed by balanced piston valves which are controlled by the action of live steam only. All tappets, levers, springs, rocker shafts, tubes or other outside gear which require lubrication and attention are dispensed with.

A special feature of the **"Bawden"** piston valves is the arrangement for catching leakage due to wear and tear, for preventing them from getting into equilibrium at their driving ends. This important feature forms part of the patent claim and results in placing the **"Bawden"** pump ahead of all others in consequence of the much longer time it will work without repairs.

The steam piston is automatically cushioned at each end of the cylinder by a special design of the two main steam ports, therefore dispensing with all adjusting mechanism to compensate variations of speed, etc., and together with the allocation of the drain cocks make the cushion effective under any emergency.

This pump has no dead centres; does not hang up and cannot be held up. It makes a full length stroke at any piston speed and on any duty.

Our Guarantee

A. 25% saving in steam consumption over all standard duplex pumps.

B. To make a full stroke of the piston under all conditions.

C. Has no dead centres.

D. Run at any working speed without adjustment of any kind.

E. Not to knock or bang.

F. Pumps to be all we guarantee, or returned at our expense.

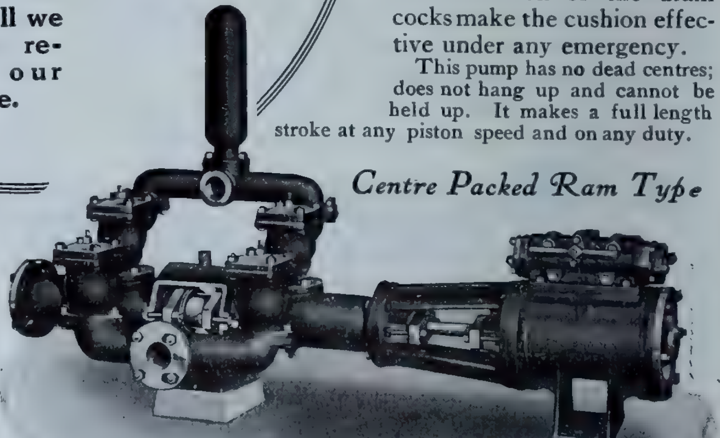
THE WATER ENDS

The water ends are built on entirely new and improved designs, and offer the greatest facilities for inspection and repair.

The valve seats are driven in on special taper, and held solid with brass stoppers through the top covers; this is much better and a more simple method than using the screwed seats, which in practice are found to rust and shake loose.

The **"Bawden"** pumps are heavily constructed and have an increased number of bolts to meet modern steam pressures. "T" head and through bolts are used instead of studs, all face joints are machined and every part is manufactured strictly to gauge and therefore interchangeable.

Every pump undergoes a rigid test before leaving our factory, andcarries our guarantee to be all that we claim in every way.



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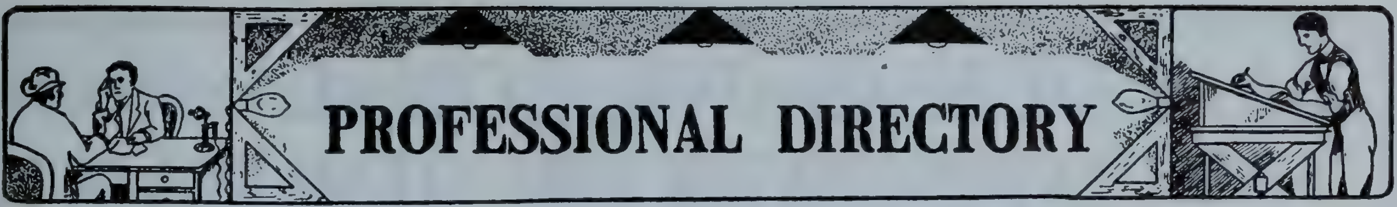

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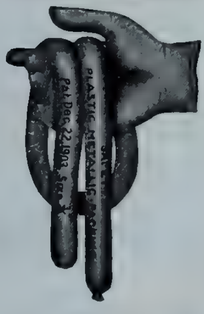

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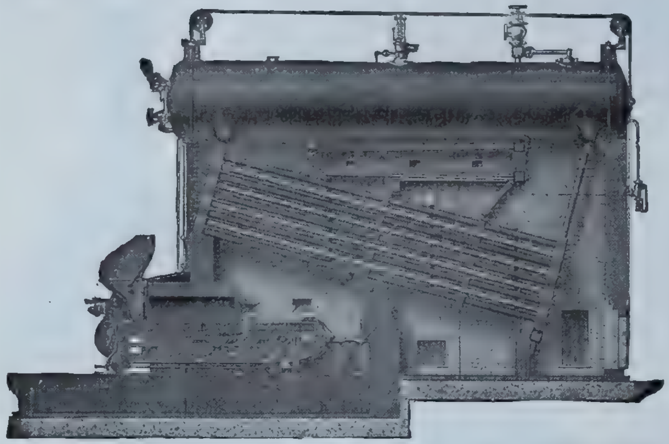

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Scale and Economy cannot exist in the same boilers.

Enter scale—exit economy.

And that is true whether your plant is small or large, whether you have the most expensive boiler equipment in the world or the least expensive.

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Dearborn Treatment IS NOT a cure-all boiler compound.

It is made to suit the conditions that exist in each plant, after a careful analysis of the boiler feed water has shown what these conditions are.

That is why Dearborn Treatment is successful while cure-all compounds fail.

Send us a gallon of your feed water and let us show you how inexpensively you can get rid of your scale troubles

Dearborn Chemical Company of Canada, Limited

TORONTO, CANADA

General Office and Works: 1220 to 1230 Dundas Street

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Graton & Knight Mfg. Co., Montreal.

Distillers.
Canadian Griscom-Russell Co., Ltd., Montreal.

Distilling Apparatus
Frick Co., Waynesboro, Franklin Co.,
Griscom-Russell Co., New York.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Double Pipe Condensers.
Frick Co., Waynesboro, Franklin Co.,

Dry Cleaners Systems.
S. F. Bowser & Co., Inc., Toronto.

Drying Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Dynamos.
W. H. Allen Son & Co., Bedford,
Can. British Eng. Co., Winnipeg.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd., Montreal

Economizers.
Babcock & Wilcox Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd., Montreal
Theodore Kipp Co., Winnipeg.

Electric Irons.
Northern Electric Co., Ltd., Montreal.

Electrical Accessories and Machinery.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
Duncan Electrical Co., Montreal.
Theodore Kipp Co., Winnipeg.
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.

Electrical Repairs.
Siemens Co. of Canada, Ltd., Montreal

Electrical Supplies.
Duncan Electrical Co., Montreal.
Northern Electric Co., Ltd., Montreal

Elevators.
John McDougall Caledonian Iron Works, Montreal.

Elevating Machinery.
C. O. Bartlett & Snow Co. of Canada, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
C. W. Hunt Co., New York.
Jeffrey Manufacturing Co., Columbus.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Engines, Automatic and Drop Valve.
Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd. Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
W. H. Allen Son & Co., Bedford, Eng.
Can. British Eng. Co., Winnipeg.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

Engines, High Speed, Steam.
W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
Can. British Eng. Co., Winnipeg.
John Inglis Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks. Montreal.
International Engineering Works, Ltd., Amherst, N.S.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford, Eng.
Canadian Fairbanks Morse Co. Ltd., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Engines, Saw Mill.
W. H. Allen Son & Co., Bedford, Eng.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Works, Ltd., Amherst, N.S.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford,
Boving & Co., of Canada, Limited, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Works, Montreal.
Kerr Engine Co., Walkerville.
International Engineering Works, Ltd., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
International Engineering Wks., Ltd., Amherst, N.S.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.

Evaporators.
Canadian Griscom-Russell Co., Ltd., Montreal.

Exhaust Fans.
Griscom-Russell Co., New York.
W. H. Allen Son & Co., Bedford, Eng.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia.

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.
Griscom-Russell Co., New York.

Fans, Ventilating.
B. F. Sturtevant Co., Boston, Mass.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
National Pipe Bending Co., New Haven, Conn.
International Engineering Wks., Ltd., Amherst, N.S.
Nobis Engineering Co., Toronto.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Griscom-Russell Co., New York.

Filters.
Canadian Griscom-Russell Co., Ltd., Montreal.
John McDougall Caledonian Iron Works, Montreal.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.
Theodore Kipp Co., Winnipeg.

Fire Extinguishers and Fire Alarm Apparatus.
Northern Electric Co., Ltd., Montreal.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick and Clay.
Betson Plastic Fire Brick Co., Rome, N.Y.
Ideal Incinerator Co., Toronto.

Fire Box Blocks.
Betson Plastic Fire Brick Co., Rome, N.Y.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flue Blowers.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.

Flue Gas Analysis Instruments.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Friction Leathers.
Graton & Knight Mfg. Co., Montreal.

Furnaces.
John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert.

Furnace Linings and Arches.
Betson Plastic Fire Brick Co., Rome.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.

Fuses, Renewable.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Monarch Refillable Fuse Co., Hamilton, Ont.

Gas Analysis Instruments, Etc.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gaskets, Rubber, Asbestos, Lead Copper and Leather.
Can. Gasket Co., Bridgeburg, Ont.
Durabla Mfg. Co., New York.
Frick Co., Waynesboro, Franklin Co.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

Gas Producer Plants.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene and Oil Storage and Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Ohio Brass Co., Mansfield, Ohio.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges, Ammonia, Oil, Gas, Air.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges, Water.
Jenkins Bros., Ltd., Montreal.
The Lunkenheimer Co., Cincinnati, O.
Ohio Brass Co., Mansfield, Ohio.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Gears, Cut, Worm, Mortise.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

Generators and Convertors.
W. H. Allen Son & Co., Bedford,
Can. British Eng. Co., Winnipeg.
Griscom-Russell Co., New York.
Siemens Co. of Canada, Ltd., Montreal
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Northern Electric Co., Ltd., Montreal.

Gongs.
Northern Electric Co., Ltd., Montreal.

Governors, Water Wheel.
W. H. Allen Son & Co., Bedford,
Can. Allis-Chalmers, Ltd., Toronto.

Graphite, Boiler.
Commercial Oil Co., Hamilton.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Graphitol.
C. C. Snowdon, Calgary.

Grates
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.

Grease Cups.
Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.

Greases.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
McColl Bros. & Co., Winnipeg, Man.
C. C. Snowdon, Calgary.

Hand Leathers or Pads.
Graton & Knight Mfg. Co., Montreal.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Heating Engineers.
Nobis Engineering Co., Toronto.
Theodore Kipp Co., Winnipeg.

Hoists.
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Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Nobis Engineering Co., Toronto.

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C. W. Hunt Co., New York.
John Inglis Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
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Bare and Insulated Electric Wire

Electric Light Line Wire. Incandescent or Flexible Cords.

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Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER
1144 Homer Street

The "Monarch" Refillable Fuse

MONARCH REFILLABLE FUSE
A Sure Contact

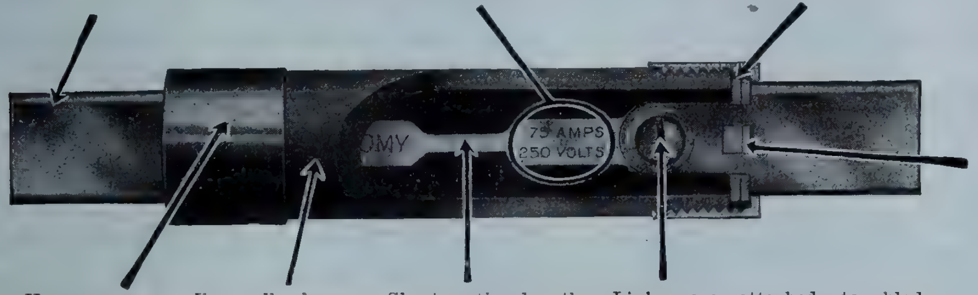
Knife Blade Type with one end cut away to disclose the method of forming, the contact between the fuse ribbon and the blade.

The Monarch Refillable Fuse is constructed with all parts Die Stamped, making the parts accurate and interchangeable, thereby making the **refilling very simple**, as the different parts will fit either cap. Our **Spring Gripping** contacts are made of copper, assuring proper carrying capacity and cooling surface.

When you buy Monarch Refillable fuses you get **efficiency, reasonable price** and **prompt shipment**.

Write for circular giving full description.

The Monarch Refillable Fuse Co., Ltd., Hamilton, Canada


Round edge hard drawn copper.
Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.
This venting feature allows no fire to escape, even on severe short circuits.
Washer assembly centres, locks in position and aligns blades.
Heavy solid brass cap.
Unusually heavy gray horn fiber shell.
Short, active length of element assures uniform performance.
Links are attached to blade member by heavy machine screws.
OMY
75 AMPS
250 VOLTS

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are **reducing fuse Maintenance expense** over 80 per cent. by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
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Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

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- Geo. H. Tod, Toronto.
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Indicators Electric—All Types.
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- Can. Westinghouse Co., Hamilton.
- Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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- Griscom-Russell Co., New York.
- Ideal Incinerator Co., Toronto.

Indicators, Steam and Gas Engine.
- Can. Fairbanks-Morse Co., Montreal.

Indicators—Ammonia, Hydraulic.
- Detroit Lubricator Co., Walkerville.

Injectors.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Penberthy Injector Co., Windsor.

Instruments.
- Northern Electric Co., Ltd., Montreal.

Iron Filler.
- Imperial Waste & Metal Co., Montreal.

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- Commercial Oil Co., Hamilton.

Lace Leathers.
- Graton & Knight Mfg. Co., Montreal.

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- Canadian General Electric Co., Ltd., Toronto.
- Can. Sunbeam Lamp Co., Toronto.
- Northern Electric Co., Ltd., Montreal.

Lamps, Arc, Incandescent.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian Westinghouse Co., Hamilton
- P. H. Klein, Jr., Co., Montreal.
- Northern Electric Co., Ltd., Montreal.

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- Jos. Dixon Crucible Co., Jersey City.
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- Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
- Darling Bros., Montreal.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.
- Manzel Bros. Co., Buffalo, N.Y.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.

Magnetos.
- Northern Electric Co., Ltd., Montreal.

Mechanical Stokers.
- Babcock & Wilcox, Montreal.
- Ed. Bennis & Co., Little Hulton, Bolton, Eng.
- Jones Underfeed Stoker Co., Toronto.
- Murphy Iron Works, Detroit, Mich.
- Geo. H. Tod, Toronto.

Measuring Instruments.
- Northern Electric Co., Ltd., Montreal.

Metal Spools.
- American Pulley Co., Philadelphia.

Meters, Electric.
- Can. British Eng. Co., Winnipeg.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton.
- Monarch Electric Co., St. Lambert,
- Siemens Co. of Canada, Ltd., Montreal

Meters, Steam.
- Nobis Engineering Co., Toronto.

Meters, Water.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Siemens Co. of Canada, Ltd., Montreal.

Mica.
- Kent Brothers, Kingston, Ont.

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- W. H. Allen Son & Co., Bedford,
- Can. Fairbanks-Morse Co., Montreal.
- Jenckes Machine Co., Sherbrooke, Que
- International Engineering Works, Ltd., Amherst, N.S.
- Goldie & McCulloch Co., Galt.
- Theodore Kipp Co., Winnipeg.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.
- Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
- Bawden Machine Co., Toronto.

Motors.
- W. H. Allen Son & Co., Bedford,
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Northern Electric Co., Ltd., Montreal.
- Siemens Co. of Canada, Ltd., Montreal.

Motor Starters and Controllers.
- W. H. Allen Son & Co., Bedford, Eng
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Siemens Co. of Canada, Ltd., Montreal.

Office Railings.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
- Can. Detroit Lubricator Co., Windsor.
- Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
- S. F. Bowser & Co., Inc., Toronto.
- Darling Bros., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Heaters and Coolers.
- Griscom-Russell Co., New York.

Oil Separators.
- Babcock & Wilcox, Montreal.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Canadian Griscom-Russell Co., Ltd., Montreal.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Liberty Mfg. Co., Pittsburg.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Smart-Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
- S. F. Bowser & Co., Inc., Toronto.
- Theodore Kipp Co., Winnipeg.
- Lunkenheimer Co., Cincinnati, O.

Oils, Lubricating.
- Can. Oil Companies, Ltd., Toronto.
- McColl Bros. & Co., Winnipeg, Man.
- C. C. Snowdon, Calgary.

Packing, Engine.
- Can. Gasket Co., Bridgeburg, Ont.
- Can. H. W. Johns-Manville Co., Toronto.
- Garlock Packing Co., Hamilton, Ont.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Hydraulic.
- Greene, Tweed & Co., New York.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Packing, Metallic.
- Holmes Metallic Packing Co., Wilkesbarre, Pa.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
- Goetze-Gasket & Packing Co., New Brunswick, N.J.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Garlock Packing Co., Hamilton, Can.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Sheet.
- Canadian Consolidated Rubber Co., Ltd., Montreal.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Jenkins Bros., Ltd., Montreal.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
- Canadian H. W. Johns-Manville Co., Toronto.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Greene, Tweed & Co., New York.
- Nobis Engineering Co., Toronto.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
- Graton & Knight Mfg. Co., Montreal.

Patents.
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Penstocks.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.

Pillow Blocks.
- Can. Bond Hanger & Coupling Co., Alexandria.
- Elmira Machinery & Transmission Co., Elmira, Ont.

Pipe Bending.
- Nobis Engineering Co., Toronto.

Pipe Coils.
- National Pipe Bending Co., New Haven, Conn.
- York Mfg. Co., York, Pa.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
- Oster Mfg. Co., Cleveland, O.

Pipe Steel.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.

Pipe (Second-hand).
- Imperial Waste & Metal Co., Montreal.

Pipes, Water.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Pacific Coast Pipe Co., Vancouver, B.C.

Piping and Fittings.
- Frick Co., Waynesboro, Franklin Co. Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.
- York Mfg. Co., York, Pa.

Piping, Steam.
- Babcock & Wilcox, Montreal.
- Imperial Waste & Metal Co., Montreal.

Plate Work.
- Can. Allis-Chalmers, Ltd., Toronto.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que.
- Waterous Engine Works Co., Brantford.

Pneumatic Chain Blocks.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Polish, Metal.
- G. W. Hoffman, Indianapolis.

Power Pumps.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- Goldie & McCulloch Co., Galt.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.
- Waterous Engine Works Co., Brantford.
- Canadian H. W. Johns-Manville Co., Ltd. Toronto.
- Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
- American Pulley Co., Philadelphia.
- Can. Bond Hanger & Coupling Co., Alexandria, Ont.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery & Transmission Co., Elmira, Ont.
- Goldie & McCulloch Co., Galt.
- Jeffrey Manufacturing Co., Columbus.
- Jenckes Machine Co., Sherbrooke,
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Waterous Engine Works Co., Brantford.
- Siemens Co. of Canada, Ltd., Montreal.

Presses.
- John Inglis Co., Ltd., Toronto.

Pulleys.
- American Pulley Co., Philadelphia.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery and Transmission Co., Elmira, Ont.
- Jeffrey Manufacturing Co., Columbus.
- Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- Escher, Wyss & Co., Toronto.
- Jeffrey Manufacturing Co., Columbus.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.

Pump Leathers.
- Graton & Knight Mfg. Co., Montreal.

Pumping Machinery.
- American Steam Pump Co., Battle Creek, Mich.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- Bawden Machine Co., Ltd., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.
- Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical
- W. H. Allen, Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Jeffrey Manufacturing Co., Columbus.

Pump Governors and Regulators.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- G. M. Davis Regulator Co., Chicago.
- Elliott Co., Pittsburgh, Pa.
- Smart-Turner Machine Co., Ltd., Hamilton.
- Watson & McDaniel Co., Philadelphia.

Pump Strainers.
- Canadian Steam Boiler Equipment Co., Toronto.
- Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
- W. H. Allen Son & Co.; Bedford, Eng.
- American Steam Pump Co., Battle Creek, Mich.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Pumps, Contractors'.
- W. H. Allen Son & Co., Bedford, Eng.
- William Hamilton Co., Ltd., Peterborough.

Pumps, Hand and Power.
- S. F. Bowser & Co., Inc., Toronto.

Pumps, Centrifugal.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Bromell Patents Co., Ltd., Glasgow, Scotland.
- John Inglis Co., Ltd., Toronto.
- Engineering Works of Canada Ltd., Montreal.
- Canadian Boving Co., Toronto.
- Escher, Wyss & Co., Toronto.
- E. Leonard & Sons, London, Ont.
- John McDougall Caledonian Iron Works, Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.
- Theodore Kipp Co., Winnipeg.
- Turbine Equipment Co., Toronto.
- Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
- American Steam Pump Co., Battle Creek, Mich.
- The Bawden Machine Co., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Pumps, Hydraulic, Pressure.
- American Steam Pump Co., Battle Creek, Mich.
- Bawden Machine Co., Ltd., Toronto.
- Can. Allis-Chalmers, Ltd., Toronto.
- John Inglis Co., Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Pump Leathers.
- Graton & Knight Mfg. Co., Montreal.

Pumps, Oil.
- The Bawden Machine Co., Toronto.
- S. F. Bowser & Co., Inc., Toronto.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.
- Manzel Bros. Co., Buffalo, N.Y.
- Smart-Turner Machine Co., Ltd., Hamilton.

Pumps, Steam.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford,
- The Bawden Machine Co., Toronto.
- S. F. Bowser & Co., Inc., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Goldie & McCullough Co., Galt.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Pumps, Triplex.
- William Hamilton Co., Ltd., Peterborough.

Pumps, Vacuum.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- C. A. Dunham Co., Toronto.
- John Inglis Co., Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Pump Tank, Receiver.
- American Steam Pump Co., Battle Creek, Mich.
- Can. Allis-Chalmers, Ltd., Toronto.

Pyrometers.
- Jas. Morrison Brass Mfg. Co., Toronto.

Rails (Relaying).
- Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
- Jas. Morrison Brass Mfg. Co., Toronto.

Railway—Industrial.
- C. W. Hunt Co., New York.

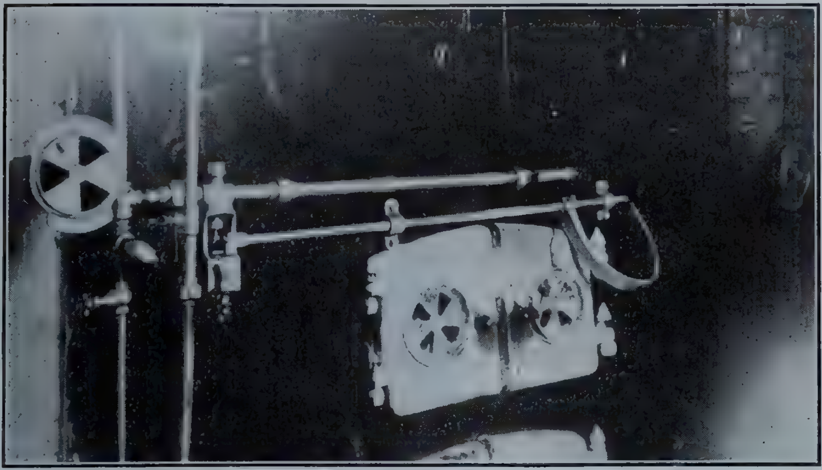
Reboilers.
- Frick Co., Waynesboro, Franklin Co., Pa.

Recording Instruments.
- Northern Electric Co., Ltd., Montreal.
- Theodore Kipp Co., Winnipeg.

Reels.
- American Pulley Co., Philadelphia.

Refrigerator Doors, Windows, etc.
- Jones Cold Store Door Co., Hagerstown, Md.

Refrigerating Engineers.
- Arctic Ice Machine Co., Canton, Ohio.
- Chas. Bishop, Montreal.



GIBBONS-KEMP

Oxygen Fuel System

Consists of a series of coned devices built into the side walls, bridge wall and front of boiler setting. The object is to mingle heated oxygen with the gases, when liberated from the fuel, and by so doing we get perfect combustion. A current of air is taken from the front of the boiler and passes along the coned side devices three times before it is delivered to the fire.

A current of air is also passed into a coned device placed within the bridge wall. Also a small steam jet, taking about one per cent. of the boiler capacity, is passed through the superheater, placed in front of the boiler setting, and is used only as a force for the purpose of mingling the oxygen with the carbon gases during firing.

An automatic valve, as shown in cut, is used to control the steam jet, which opens when the fire door is opened, and closes from thirty seconds to five minutes after the door is closed, and can be timed to suit the quality of coal used. Pre-heated air is used for draft, effecting the same economical results as the feeding of heated water in place of cold to the boiler. All heat used for pre-heating the oxygen and draft is waste heat, and therefore takes nothing from the efficiency of the boiler.

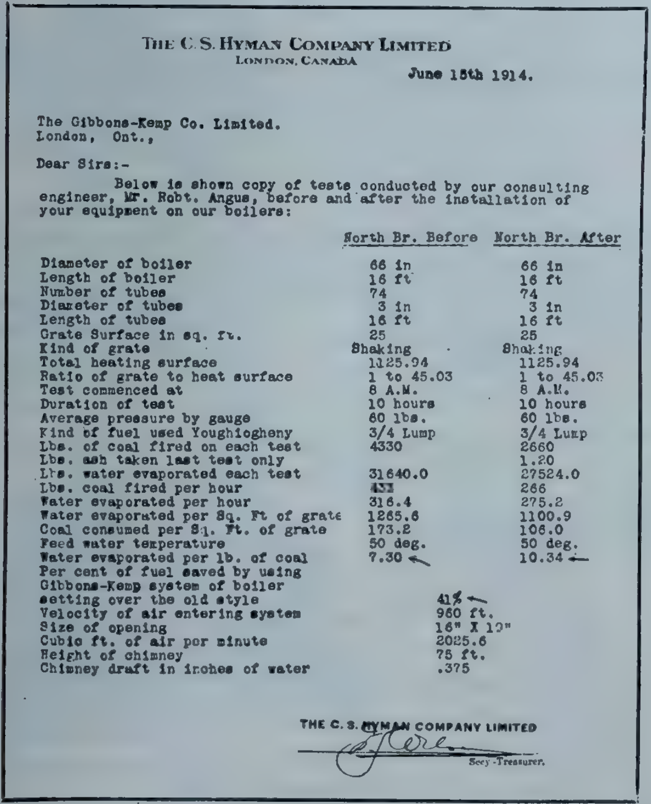
No force draft is used—the whole system being perfectly automatic, and although an intense heat is generated, it is distributed evenly over the full length of the boiler. No machinery is used in this installation, so there is nothing to get out of order to cause expensive repairs. The first cost is the only cost, and provided the fire lining is kept in repair, which has to be done in any case, our installation will last the life of the boiler.

This is the only system whereby you will get full 80% efficiency from your coal.

We guarantee a 15% saving in fuel, regardless of the quality of fuel, or whether it be coal, coke or wood, and guarantee to eliminate the smoke nuisance. If we do not produce these results we ask no pay.

Opposite is a reproduced report of an unbiased test made by C. S. Hyman Co., Limited, of London, Ont., after our installation was made.

Further particulars and list of other plants equipped, with copies of boiler tests, on request.



THE C. S. HYMAN COMPANY LIMITED
LONDON, CANADA

June 15th 1914.

The Gibbons-Kemp Co. Limited.
London, Ont.,

Dear Sirs:-

Below is shown copy of tests conducted by our consulting engineer, Mr. Robt. Angus, before and after the installation of your equipment on our boilers:

	North Br. Before	North Br. After
Diameter of boiler	66 in	66 in
Length of boiler	16 ft	16 ft
Number of tubes	74	74
Diameter of tubes	3 in	3 in
Length of tubes	16 ft	16 ft
Grate Surface in sq. ft.	25	25
Kind of grate	Shaking	Shaking
Total heating surface	1125.94	1125.94
Ratio of grate to heat surface	1 to 45.03	1 to 45.03
Test commenced at	8 A.M.	8 A.M.
Duration of test	10 hours	10 hours
Average pressure by gauge	60 lbs.	60 lbs.
Kind of fuel used Youghiogheny	3/4 Lump	3/4 Lump
Lbs. of coal fired on each test	4330	2660
Lbs. ash taken last test only		1.20
Lbs. water evaporated each test	31640.0	27524.0
Lbs. coal fired per hour	433	266
Water evaporated per hour	316.4	275.2
Water evaporated per Sq. Ft of grate	1265.6	1100.9
Coal consumed per Sq. Ft. of grate	173.2	106.0
Feed water temperature	50 deg.	50 deg.
Water evaporated per lb. of coal	7.30 ←	10.34 ←
Per cent of fuel saved by using Gibbons-Kemp system of boiler setting over the old style	41% ←	
Velocity of air entering system	960 ft.	
Size of opening	16" X 10"	
Cubic ft. of air per minute	2025.6	
Height of chimney	75 ft.	
Chimney draft in inches of water	.375	

THE C. S. HYMAN COMPANY LIMITED
Secy.-Treasurer.

Gibbons-Kemp Co.

LIMITED

15 Greene Swift Building,
London, Ont.

Branch Office: 53 Yonge St., Toronto, Ont.

Can. De La Vergne Co., Limited, Montreal.

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Arctic Ice Machine Co., Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Theodore Kipp Co., Winnipeg.
Linde British Refrigeration Co., Montreal.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

Refuse Destructors.
Canadian Griscom-Russell Co., Ltd., Montreal.
Ideal Incinerator Co., Toronto.

Regulators, Pressure.
C. A. Dunham Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Welo Steam Specialty Co., Toronto.

Revolving Doors for Hardening Rooms.
Jones Cold Store Door Co., Hagerstown, Md.

Rheostats.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd., Montreal

Roofings—Asbestos and Wool Felts.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

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Herbert Morris Crane & Hoist Co., Ltd., Toronto.

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Cling Surface Co., Buffalo.

Rotary Converters.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd., Montreal

Rubber Goods.
Canadian Consolidated Rubber Co., Ltd., Montreal.

Rubber Hose.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Quaker City Rubber Co., Philadelphia.

Runways, Hand Operated.
Herbert Morris Crane & Hoist Co., Ltd.. Toronto.

Runways, Electric.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Rubber Molds.
The Bawden Machine Co., Toronto.

Safes.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Safety Valves.
Can. Fairbanks-Morse Co., Montreal.
Lunkenheimer Co., Cincinnati, O.

Sash Pulleys.
American Pulley Co., Philadelphia.

Self-landing, Self-delivery Hoists.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Scale Removers.
William B. Pierce Co., Buffalo, N.Y.

Separators, Oil, Steam and Ammonia.
Frick Co., Waynesboro, Franklin Co., Pa.
Griscom-Russell Co., New York.

Shafting.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.

Shaking and Dumping Grates.
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Waterous Engine Wks. Co., Brantford.

Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Sign Receptacles.
Duncan Electrical Co., Montreal.

Smoke Consumers.
Canadian Steam Boiler Equipment Co., Toronto.

Smoke Boxes, Stacks.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Wks. Co., Brantford.

Smokeless Furnaces.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks., Detroit, Mich.
Geo. H. Tod, Manning Chambers, Toronto.

Soap, Linseed Oil.
McColl Bros. & Co., Winnipeg.

Special Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Sprocket Chain Attachments.
Waterous Engine Wks. Co., Brantford.

Spur Wheels.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford.

Stand Pipes.
John Inglis Co., Ltd., Toronto.

Stand Pipes, Steel.
Can. Allis-Chalmers, Ltd., Toronto.
William Hamilton Co., Ltd., Peterborough.

Stationary Gas Engine Oil.
Commercial Oil Co., Hamilton.

Steam Separators.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.
Arctic Ice Machine Co., Canton, Ohio.

Steam Specialties.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
D. G. C. Valve Co. of Canada, Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.

Steam Traps.
V. D. Anderson Co., Cleveland, O.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Can. Morehead Mfg. Co., Woodstock.
Nobis Engineering Co., Toronto.
Peacock Bros., Montreal.
Watson & McDaniel Co., Philadelphia.
Welo Steam Specialty Co., Toronto.

Steam Turbine Blowers.
International Engineering Wks., Ltd., Amherst, N.S.

Steam Turbine Generators.
W. H. Allen Son & Co., Bedford, Eng.
International Engineering Wks., Ltd., Amherst, N.S.
Siemens Co. of Canada, Ltd., Montreal

Steam Turbine Pumps.
W. H. Allen, Son & Co., Bedford, Eng.

Steel Tanks.
William Hamilton Co., Ltd., Peterborough.

Stokers.
W. H. Allen, Son & Co., Bedford, Eng.
Detroit Stoker Co., Detroit.
Hare Engineering Co., Toronto.
Illinois Stoker Co., Alton, Ill.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Theodore Kipp Co., Winnipeg.
Geo. H. Tod, Manning Chambers, Toronto.

Strainers.
W. H. Allen, Son & Co., Bedford, Eng.
Elliott Co., Pittsburg, Pa.

Superheaters, Steam.
Babcock & Wilcox, Montreal.

Switchboards, Light, Telephone and Power.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Engineering Works of Canada, Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd., Montreal.

Switches and Switch Boxes.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Duncan Electrical Co., Montreal.
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.
Orenstein-Arthur Koppel Co., Pittsburg.
Siemens Co. of Canada, Ltd., Montreal.

Tachometers.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Tanks, Blow-off.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal.

Tanks, Freezing, Storage and Water Cooling.
Frick Co., Waynesboro, Franklin Co., Pa.

Tanks, Oil.
S. F. Bowser & Co., Inc., Toronto.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.

Tanks, Water.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.
Pac. Coast Pipe Co., Vancouver, B.C.

Technical Books.
Theo. Audel & Co., New York.
American School of Correspondence, Chicago.

Telephones.
Northern Electric Co., Ltd., Montreal.

Telegraph Systems.
Northern Electric Co., Ltd., Montreal.

Temperature Regulators.
Welo Steam Specialty Co., Toronto.

Thermometers.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Tools; Scraping, Beading.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Track Systems.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Transformers.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.
Siemens Co. of Canada, Ltd., Montreal.

Transmission Machinery.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
Goldie & McCulloch Co., Galt, Ont.
John Inglis Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

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Trolley Hoists.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Trucks.
John Inglis Co., Ltd., Toronto.

Trucks, Factory.
Can. Fairbanks-Morse Co., Montreal.
C. W. Hunt Co., New York.

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C. W. Hunt Co., New York.

Tube Cleaners.
Can. Allis-Chalmers, Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg, Pa.

Tube Cutters.
Liberty Mfg. Co., Pittsburg, Pa.

Tubes, Boilers.
Babcock & Wilcox, Montreal.

Tube Expanders.
Liberty Mfg. Co., Pittsburg, Pa.

Tungsten Lamps.
Can. Sunbeam Lamp Co., Toronto.
Can. Tungsten Lamp Co., Hamilton, Ont.
Canadian General Electric Co., Ltd., Toronto.

Turbine Water Wheels.
W. H. Allen, Son & Co., Bedford, Eng.
Canadian Boving Co., Hamilton.
Chas. Barber & Sons, Meaford, Ont.
Escher, Wyss & Co., Toronto.
John Inglis Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que.
William Hamilton Co., Ltd., Peterborough.

Turbines, Steam.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
De Laval Steam Turbine Co., Trenton, N.J.
Escher, Wyss & Co., Toronto.
International Engineering Wks., Ltd., Amherst, N.S.
Theodore Kipp Co., Winnipeg.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Turbine Equipment Co., Toronto.

Turntables.
Orenstein-Arthur Koppel Co., Pittsburg.

Unions.
Can. Fairbanks-Morse Co., Montreal.
Dart Union Company, Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Vacuum Governors.
Smart - Turner Machine Co., Ltd., Hamilton.
Canadian Steam Boiler Equipment Co., Toronto.
G. M. Davis Regulator Co., Chicago.

Vacuum Regulating Valves.
Bromell Patents Co., Ltd., Glasgow, Scotland.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Welo Steam Specialty Co., Toronto.

Vacuum Traps.
D. G. C. Valve Co. of Canada, Toronto.
C. A. Dunham Co., Toronto.
Can. Morehead Mfg. Co., Woodstock, Ont.

Valve, Disk.
Durabla Mfg. Co., New York.
Goetze-Gasket & Packing Co., New Brunswick, N.J.

Valve Leather.
Graton & Knight Mfg. Co., Montreal.

Valve Oils.
Commercial Oil Co., Hamilton.

Valve, Reseating Machines.
Bromell Patents Co., Ltd., Glasgow, Scotland.
Darling Bros., Montreal.

Valves.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Steam Boiler Equipment Co., Toronto.
D. G. C. Valve Co. of Canada, Toronto.
Frick Co., Waynesboro, Franklin Co., Pa.
G. M. Davis Regulator Co., Chicago.
Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Nobis Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia.

Valves, Blow-off.
Can. Fairbanks-Morse Co., Montreal.
Elliott Co., Pittsburgh, Pa.
Engineering Specialties Co., Toronto.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Watson & McDaniel Co., Philadelphia.

Valves, Gates.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Valves, Reducing.
Liberty Mfg. Co., Pittsburg, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia.
H. Mueller Mfg. Co., Ltd., Sarnia, Ont.

Valves, Radiator.
D. G. C. Valve Co. of Canada, Toronto.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Valves, Throttle.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

Valves, Hot and Cold Water Rubber.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Vaults & Vault Doors.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Ventilating.
Nobis Engineering Co., Toronto.
Theodore Kipp Co., Winnipeg.

Voltmeters.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Siemens Co. of Canada, Ltd., Montreal.

Washers, Leather.
Graton & Knight Mfg. Co., Montreal.

Waste and Wipes.
Imperial Waste & Metal Co., Montreal.

Water Columns, Gauges.
Elliott Co., Pittsburgh, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
W. J. Wall, Montreal.

Water Hose.
Liberty Mfg. Co., Pittsburgh, Pa.

Water Lifters.
Watson & McDaniel Co., Philadelphia.

Water Motors.
Elliott Co., Pittsburgh, Pa.

Water Purifiers, Softeners.
Babcock & Wilcox, Montreal.
Nobis Engineering Co., Toronto.

Water Wheels.
Chas. Barber & Sons, Meaford, Ont.
John McDougall Caledonian Iron Works, Montreal.
William Hamilton Co., Ltd., Peterborough.

Waterworks Supplies.
John Inglis Co., Ltd., Toronto.

Wattmeters.
Northern Electric Co., Ltd., Montreal.

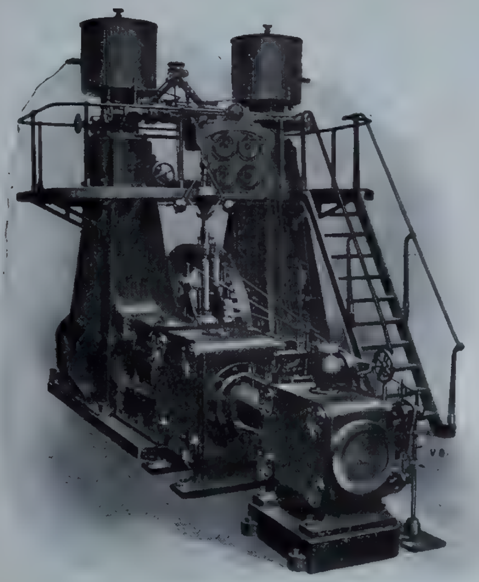
Whistles, Plain or Chime.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Wire, Bare and Insulated.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.
Northern Electric Co., Ltd., Montreal.

Wire, Magnet and Trolley.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wire, Railway Feeder & Trolley.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.

Wrenches.
Greene, Tweed & Co., New York.



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Ice-Making and Refrigerating Machine

is built for Endurance and Efficiency.

From the beginning of Refrigerating History in America to the present day, The FRICK has been built with but one purpose in view—that it would endure well the hardest work it would meet and operate efficiently.

The FRICK Machine has endured all overloads, lack of attention, excessive speeds and every other kind of hard usage to be met.

Where do you find machines operating 25 to 30 years with such low average expense and high average efficiency, running through long operating seasons without a shutdown or break of any kind? This is efficiency.

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Canadian Representatives:
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297 Campbell Ave. Toronto

FRICK COMPANY
Waynesboro, Pa., U. S. A.

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Pumping Machinery

For Every Service

Marsh and American Pumps have a reputation for extreme simplicity combined with the highest efficiency. They are built for long continuous service and may be relied upon to do their work continuously, even under the most severe conditions. They cannot short-stroke, race or pound.

MARSH VACUUM PUMP.

A Complete Line of

Boiler Feed Pumps,	Deep Well Engines,
Vacuum Pumps,	Air Compressors,
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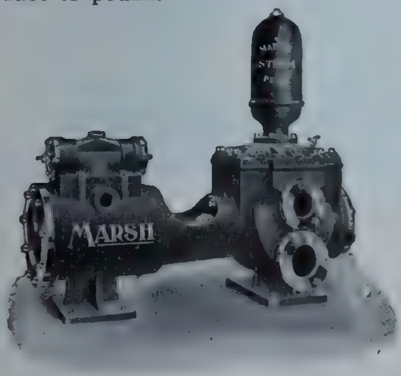

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AMERICAN STEAM PUMP CO.
BATTLE CREEK, MICH.

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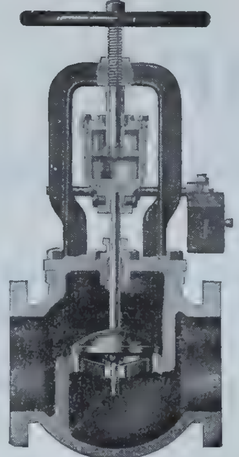
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman Machinery Co., Vancouver, B.C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited, Edmonton and Calgary



Make Sure That the Stop and Check Valves You Buy Are Properly Designed

Some Users of the Davis Class C Valve

American Locomotive Works.
International Harvester Co.
Packard Motor Car Co.
Sherwin-Williams Co.
Illinois Steel Co.
National Tube Co.
Cleveland Worsted Mills Co.
National Lead Co.
United Verde Copper Co.
Armour Glue Works.
Bemis Bag Co.
Tennessee Coal, Iron & R. R. Co.

An automatic safety device must be dependable or it is of little value. If there is a possibility of its not working in an emergency, you don't want it.

Most all Stop and Check Valves feature an internal steam dash pot. They have no indicator. There is no way of determining their working condition. Scale formation or expansion of the parts is sure to cause trouble with such valves. And you can't tell anything about their condition until an emergency occurs. It may then be too late to prevent the damage which the valves are supposed to forestall.

There is one Stop and Check Valve—The Davis Class C—that you can always depend upon. It will not stick. It will not pound. You can see it work. You can test it by hand. The internal construction is similar to a globe valve. All the moving parts except the disc are on the outside.

It has an oil, instead of a steam dash pot. No matter how slight the movement of the disc, this oil dash pot prevents pounding. The counterweight lever serves as an indicator—you can see the valve work. It also provides means for testing by hand.

Which type of valve would you prefer? The one that has trouble built right into it or the one that is designed to prevent trouble.

The demand for the Davis Class C Stop and Check Valve is increasing every day. Many prominent plants are equipped with them. Note some of those that are mentioned. When the time comes to buy valves for your plant, study the design of them all. The more you know about the others, the better you will like the Davis Class C.

G. M. Davis Regulator Company
434 Milwaukee Avenue Chicago
New York—Boston—Philadelphia—Pittsburgh—San Francisco
Makers of Valve Specialties Since 1875

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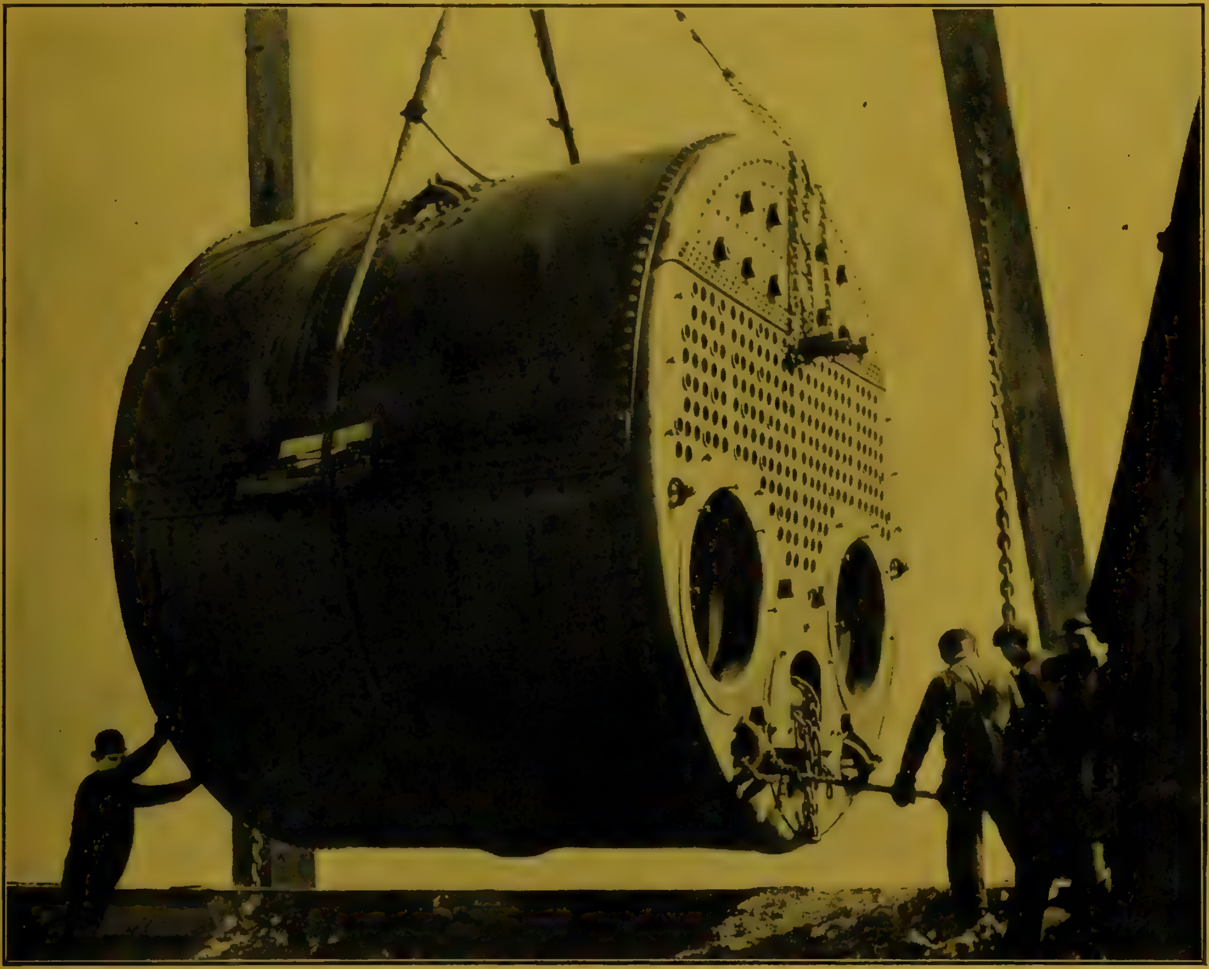
POLSON BOILERS

are built of best quality Flange Steel by skilled workmen.

The photo shows a Scotch Marine Boiler that has just been completed by us for the Steamer "Senator Derbyshire." 13′ 0 dia. x 11′ 0 long.

It is just another example of the popularity of Polson products, amongst engineers and men who know and appreciate good equipment.

Put your plans and specifications up to us.



Polson Iron Works, Limited

Toronto, Ontario

On a Grand Trunk Engine

32 YEARS

Away back in December, 1882, we sold our steam gauge, No. 12388, to the Grand Trunk Railway. Now, in June, 1914, the Grand Trunk sends No. 12388 back to us for repairs! Repairs that will cost about $1.50, and to the best of our knowledge will send this honorable old gauge on to its job again for another thirty-two years.

We're proud of No. 12388. It proves our claim that we make the honest, long wearing kind of goods—proves it up to the hilt in the only way that is final.

So much for the past.

At present we are making, if possible, better gauges than ever—gauges for every purpose. And as we would have to buy the whole magazine to tell you about all their good points, you had better let us write you direct about the line in which you are interested. As business people you will find us as good as the products we manufacture, and that IS good.

ONLY MAKERS OF GAUGES IN CANADA.

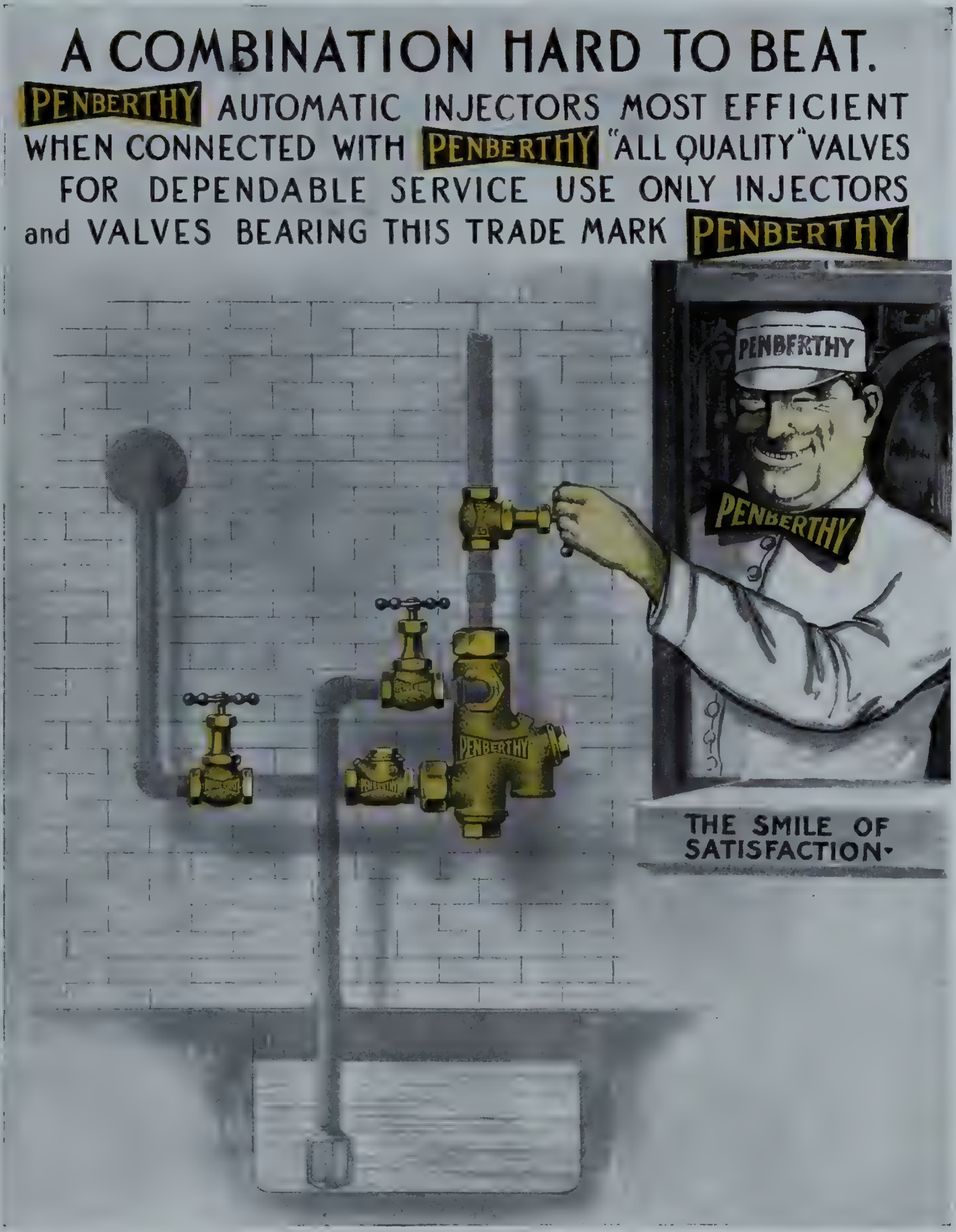
MAKERS OF AS GOOD GAUGES AS CAN BE BOUGHT.

The James Morrison Brass Manufacturing Co.
LIMITED
93-97 Adelaide St. W. TORONTO

ANNUAL EQUIPMENT AND SUPPLY DIRECTORY NUMBER

THE POWER HOUSE

VOL. VII PUBLICATION OFFICE, TORONTO, OCTOBER, 1914 No. 10.


A COMBINATION HARD TO BEAT.
PENBERTHY AUTOMATIC INJECTORS MOST EFFICIENT WHEN CONNECTED WITH PENBERTHY "ALL QUALITY" VALVES
FOR DEPENDABLE SERVICE USE ONLY INJECTORS and VALVES BEARING THIS TRADE MARK PENBERTHY
PENBERTHY
PENBERTHY
PENBERTHY
THE SMILE OF SATISFACTION.

PENBERTHY "ALL QUALITY" VALVES

Have been approved by Ontario and the Western Provinces (Pub. Wks. Depts.) for steam pressures as high as 200 lbs.

IF YOU WANT "SOMETHING BETTER IN VALVES" SPECIFY THEM.

Penberthy Injector Company, Limited, Windsor, Ontario

The MACLEAN PUBLISHING COMPANY, Limited

MONTREAL TORONTO WINNIPEG NEW YORK CHICAGO LONDON, ENG.

"INGLIS" BOILERS

For Any Service

Marine Boiler built for R. & O. Nav. Co. Str. "Rapids Prince"

"Inglis" Boilers are the best. We make all kinds for any service. We are also Sole Canadian Manufacturers of the well-known Erie City Water Tube Boilers, Vertical and Horizontal.

WRITE US.

The John Inglis Company, Limited

ENGINEERS AND BOILERMAKERS

14 Strachan Ave., Toronto, Montreal Office, 509 Can. Express Bldg.

Keep This Number of The Power House

THE advertisements in any issue of "The Power House" provide information with which every progressive and up-to-date engineer and superintendent must be familiar in order to keep pace with the advances being made in the engineering profession.

¶ The advertisements in this, as in all good technical papers, are, to the majority of readers, just as interesting and instructive, and just as closely followed as the "reading matter." They contain information about new equipment and supplies, or they review the merits of standard and reliable lines, in an authoritative, intimate and practical manner.

¶ Complete familiarity with the various types and makes of power plant machinery must necessarily form an important part of every engineer's education, and many have told us that the information secured from the editorial and ADVERTISING pages of "The Power House" has helped them to advancement, increased salaries and more responsible positions.

¶ Fully appreciating, therefore, the importance of the advertising section of "The Power House," we decided some months ago to issue this, our first,

Annual Equipment and Supply Directory Number

¶ In this issue we have endeavored to group, for your benefit, the announcements of all the worth-while manufacturers, agents and dealers selling power plant equipment and supplies. It is one number which you can keep as a complete guide in good buying. Hang it up in the engine room, in your office, or in your home. Study it carefully. Get to know the reliable and progressive firms who are represented in this issue, and become familiar with their lines. Write for further information and catalogues,—the advertiser will be glad to supply you.

¶ *Over Six Thousand* leading engineers, consulting engineers, and power superintendents, will receive this big directory number. The wise ones will preserve *their* copies and in your own interests, and out of courtesy to the progressive manufacturers and dealers whose advertisements appear herein, let us suggest that *you* preserve *your* copy, and study the advertising pages frequently, carefully, and with an open mind. In the end you will be well repaid.

THE POWER HOUSE

Hoyt Frost King's Service

Proves Its Superiority

Hoyt "**Frost King**" is especially designed for saw mills, planing mills, threshing machines, traction engines, pumps, rolling mills and pulp machinery, and all classes of **stationary** engines.

You will also find our Hoyt "NICKEL GENUINE" exceptionally good for babbitting dynamos and motors.

A careful microscopic examination of the grain of these Babbitts will verify our claim that they are **mixed to the last degree of perfection.**

If you cannot get these babbitts from your dealer, **we shall be pleased to make you a shipment of a twenty-five pound box.**

**HOYT "FROST KING"
BABBITT METAL**

Our Mixed Metal Sales Amount to Over $5,000,000 Annually.

Made in Canada

Hoyt Metal Co., Toronto, Ont.

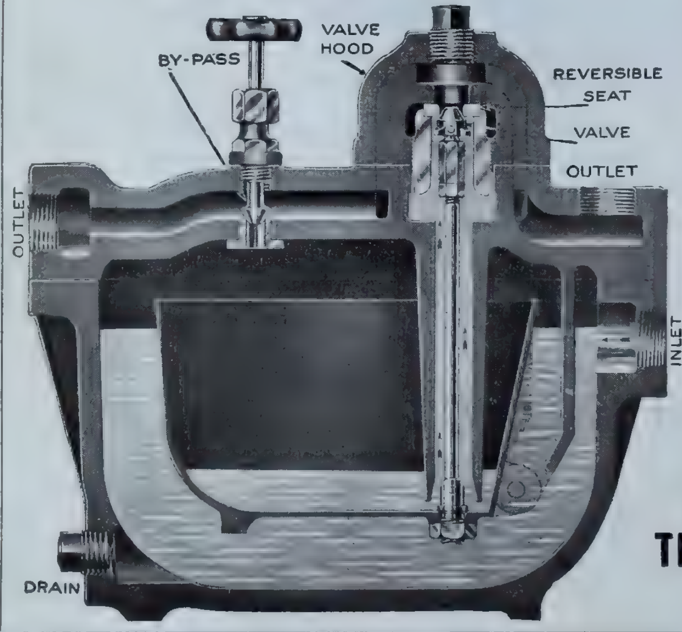
New York, N.Y. London, Eng. St. Louis, Mo.

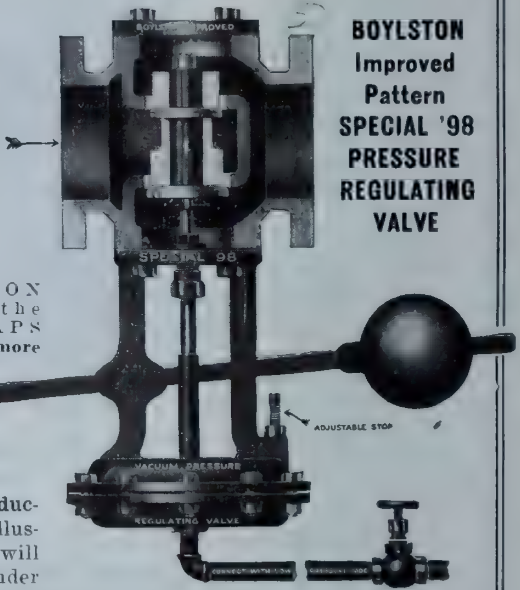
The Boylston Steam Trap

Sectional view below shows position of Float and Disc after trap has discharged. Note that the valve is now closed tight.

Open Bucket, Non-Collapsible, Hinged Float, pivoted on one end, gives greater power to open a larger valve—hence the LARGER CAPACITY of the BOYLSTON Trap.

Valve Seat is machined on both sides, and by reversing it the other side is ready for use. **Made for all pressures,** and for every service.





**BOYLSTON
Improved
Pattern
SPECIAL '98
PRESSURE
REGULATING
VALVE**

The BOYLSTON TRAPS are the HEAVIEST TRAPS MADE. **They cost more to make but are cheaper to operate and maintain.**

Write for full description.

The Pressure Reducing Valve as illustrated herewith will stand the test under all conditions in any VACUUM, ATMOSPHERIC or LOW PRESSURE SYSTEM of Steam Heating.

It is suitable for reducing from 125 lb. boiler pressure on the high side from 0 to 10 lb. on the low pressure side.

Note the heavy type of construction, insuring long life.

WRITE FOR FULL PARTICULARS.

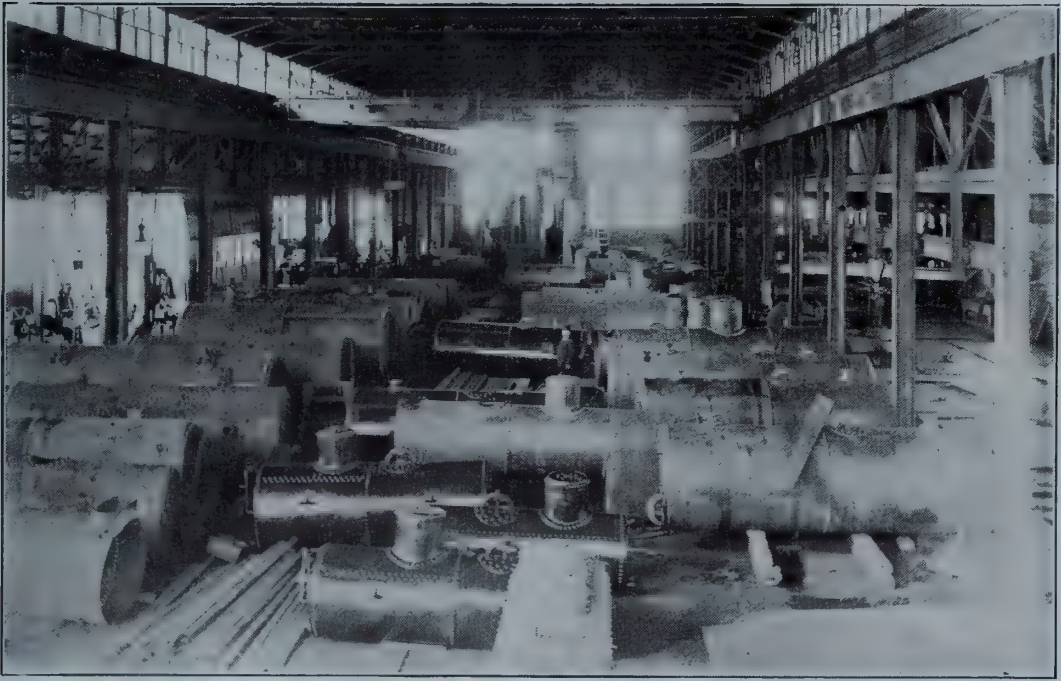
The "Welo" Steam Specialty Co., Limited

333 King Street West, Toronto, Canada

HIGHEST **QUALITY**

JENCKES BOILERS

VERTICAL TUBULAR
HOROZONTAL TUBULAR
LOCOMOTIVE TYPES
HEATING BOILERS



Our Boiler Department with Boilers in Various Stages of Construction

Made for Low, Medium and High Pressures, of the various standard styles and to pass any INSPECTION

Flange quality steel, conforming to Manufacturers' Standard Specifications, is used in shell and heads. The tubes are lap-welded or seamless steel of standard gauge and make; the rivets are of special quality steel, and the stays are steel, without welds.

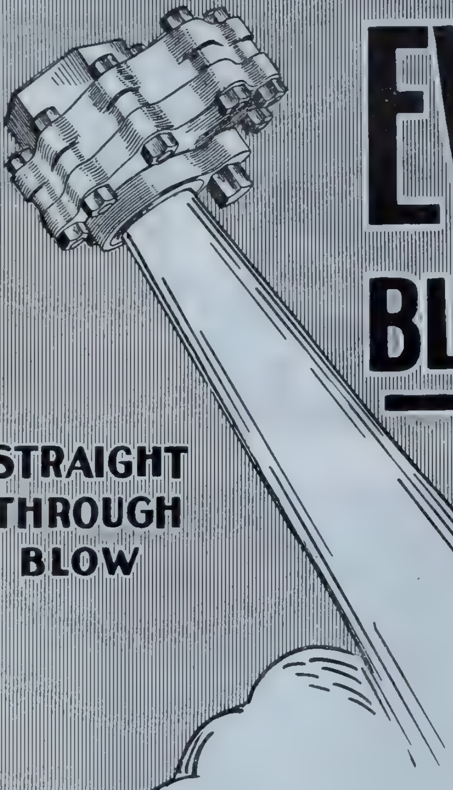
This construction is carried on with scrupulous care at every step, which is a good reason for our claim that JENCKES BOILERS MINIMIZE STOPPAGE FOR REPAIRS.

We have a large number of finished boilers in stock, from which we can make **prompt and satisfactory shipments.** We also have a variety of sizes in process of manufacture, which can be speedily completed for delivery.

The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Toronto Cobalt South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE., and ST. CATHARINES, ONT.



EVERLASTING BLOW-OFF VALVES

STRAIGHT THROUGH BLOW

End Blow-Off Leaks or Troubles

No Stuffing Box, Requires No Packing, Self Cleaning, Self Grinding Seat

The valve is composed of a top and bottom bonnet, a disc, a lever and a post. There is nothing to get out of order.

Guaranteed Perfect Service.

GUARANTEE — Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.

☛ LOOK FOR THIS MARK

It is found **only** on the genuine "Everlasting" Blow-Off Valve. It's your safeguard against imitations and inferior service.

Manufactured and Sold under Canadian Patents by

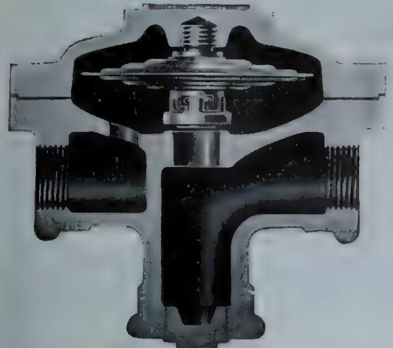
ENGINEERING SPECIALTIES COMPANY LIMITED

1080 King St. West, TORONTO, CANADA

AGENTS:
Montreal, Que.—H. L. Peller & Co. Calgary, Alta.—P. D. McLaren, Ltd. Vancouver, B.C.—Taylor-Forbes Co., Ltd. Winnipeg, Man.—A. R. Williams Machy. Co.

OVER 200,000 IN USE

SOLD ON MERITS

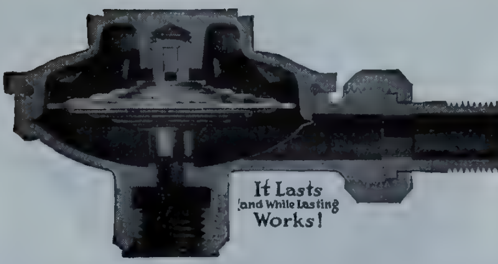


DUNHAM TRAPS FOR HIGH PRESSURE SERVICE

For draining steam mains, kettles, cookers, etc., on pressures not exceeding 100 pounds. Have large capacities and made in sizes ¾" to 3".

They are neat, easy to handle, and being small can be used in places where a larger and bulkier type, because of its size, could not be installed, except at greater expense.

A Trap of capacity at a moderate price.

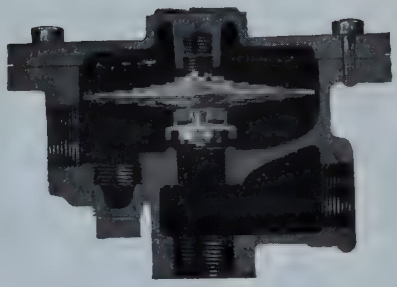


THE DUNHAM RADIATOR TRAP

Hollow Disc Thermostatic Type

Insures 100% heating efficiency at the radiator with a minimum demand on the coal pile.

Applied on the return end of each radiator in either Vacuum or Vapor System it gets rid of air binding and short circuiting of steam in return lines, because it is positive in action—passing all air and water of condensation, but **closing off tight against steam.** No expensive jet condenser needed at vacuum pump, because no steam wastes through Dunham Traps.



THE DUNHAM BLAST TRAP

Is applicable to low pressure or vacuum heating service for draining condensation from steam mains, Blast Heating Coils and dry kiln coils, cookers, kettles or any large units where steam not exceeding ten pounds pressure is used.

Thousands of them are used in all parts of the country. Operates on precisely the same principle as the Dunham Radiator Trap.

DUNHAM
HEATING
Specialties

Are built for lasting service and highest efficiency in use and economy. They show it in service.

A Dunham System of Heating for any class of building or group of buildings when designed on right lines is a lasting success. Evidence of this is found in the satisfaction shown by hundreds of users in Canada.

You should hear what they say about it. Have us put you in touch with a near user.

Separate descriptive Bulletins on each specialty gladly mailed on request.

THE FISHER REDUCING PRESSURE VALVE

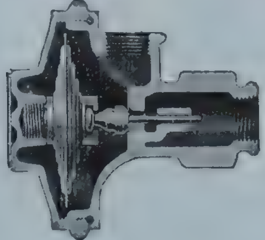
Diaphragm, lever and weight type, insuring constant low pressure. For use in connection with both the pressure and vacuum type of heating systems. Are also applicable to service where air or gas pressure is to be reduced.

Every valve thoroughly tested before shipment is made.

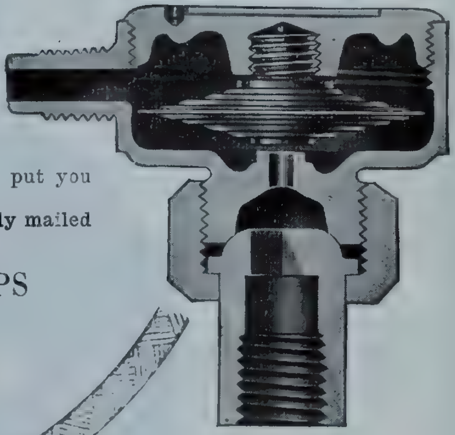
No better steam metal is obtainable than that which goes into "Fisher" goods. An "ironbound" guarantee to give satisfaction.

DUNHAM BROWNIE TRAPS

(Non-Adjustable)



Constructed of phosphor bronze entirely and are for use on pressures not exceeding 100 pounds. These traps are especially adapted for draining small kettles, sterilizers, candy machines, laundry machines, etc. They are small, of neat appearance and with large capacity. Can be opened when necessary without removing pipe connections. Made in sizes ⅜" and ½".



THE DUNHAM AIR LINE SERVICE VALVE

Eliminates air binding troubles in any gravity system of heating, and is applicable to systems having an air line. It is designed to pass air from the radiator without loss of steam. It meets and remedies air line valve troubles with the precision that is consistent with all Dunham products

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

MONTREAL—Room 20, 11 St. Sacrament St.
FORT WILLIAM—Plumbing & Engineering Supply Co.
HALIFAX—General Contractors Supply Co., Ltd., McCurdy Bldg.

VANCOUVER—520 Duncan Bldg.
CALGARY—Metals, Limited.
WINNIPEG—405 Tribune Bldg.

MADE IN CANADA

Factory of Jenkins Bros., Limited
Montreal, Canada

JENKINS BROS.'

Iron Body Globe, Angle and Check Valves

STANDARD PATTERN

Suitable for working steam pressures up to 150 pounds

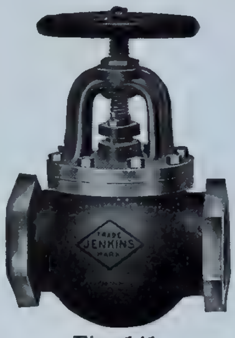


Fig. 141.
Iron Body Globe Valve Screwed with Yoke. Standard Pattern.

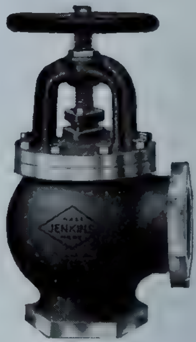


Fig. 143.
Iron Body Angle Valve Screwed with Yoke. Standard Pattern.

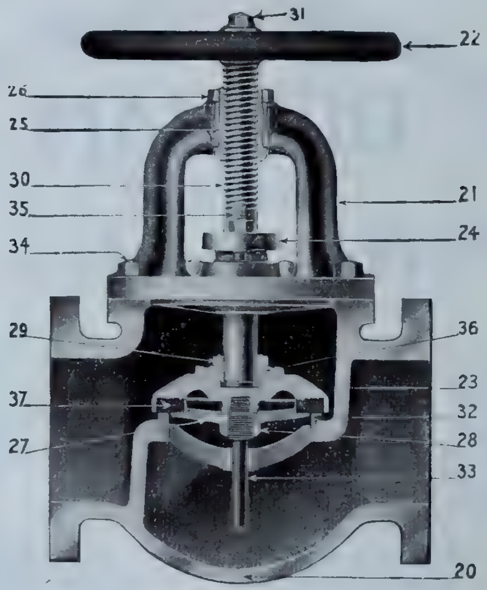


Fig. 142.
Sectional View.

DEPENDABLE

UNEQUALLED

TRADE JENKINS MARK

Jenkins Bros.

TRADE JENKINS MARK

Jenkins Bros.

ECONOMICAL

GUARANTEED

THESE valves are made in globe, angle, cross, check, Y, safety, and other patterns, and are heavier and considerably stronger than most of the standard iron body valves on the market. They are regularly fitted with the Jenkins' renewable composition Discs, and the working parts are similar in construction to the Jenkins Bros.' Standard Pattern brass valves. The yokes of the globe, angle, cross, and Y valves are wide, giving easy access to the stuffing-boxes, which can be packed under full pressure when the valves are wide open. The raised seat rings are made of high-grade steam metal composition, screwed into the body of the valve, and if necessary can be removed and renewed.

Look for the Diamond Trade-Mark!

Stocked by first-class dealers everywhere.
Catalogue mailed FREE upon request.

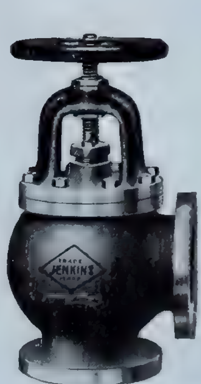


Fig. 144.
Iron Body Angle Valve Flanged with Yoke. Standard Pattern.

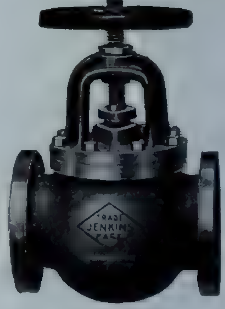


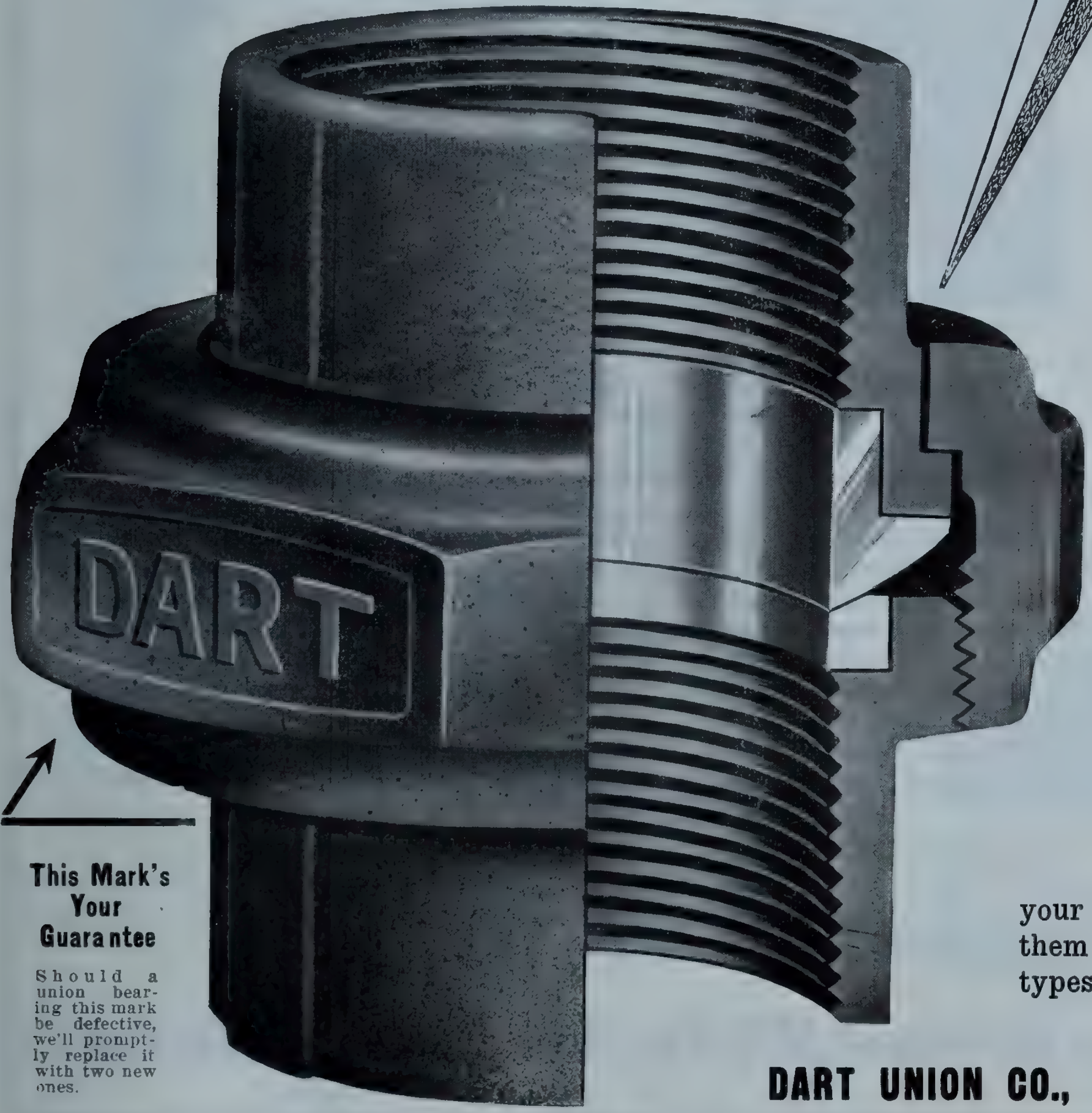
Fig. 142.
Iron Body Globe Valve Flanged with Yoke. Standard Pattern.

JENKINS BROS., LIMITED
103 ST. REMI STREET MONTREAL

BRONZE TO BRONZE

All that is necessary is to draw the two bronze faces together and you have a joint that **defies time, pressure, corrosion, vibration, expansion and contraction.** The Ball Shaped joint enables it to be **easily connected** and disconnected as often as you wish whether pipes are in or out of line.

-at the JOINT



No Corrosion

Dart Unions have no cored parts or recesses to hold moisture and sediment or obstruction to retard the flow.

We devote all our time and attention to manufacturing the "Dart," and its quality and perfection show it.

Get them from your jobber — he has them in all convenient types.

This Mark's Your Guarantee

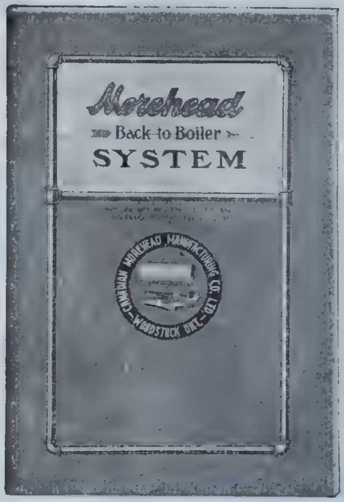
Should a union bearing this mark be defective, we'll promptly replace it with two new ones.

DART UNION CO., LTD., TORONTO

POINTS FOR STEAM USERS

and many facts for every Steam Plant Owner and Operator in

this book



Drop us a card and we'll mail you a copy FREE

The application of our Traps is so wide and varied that we shall only endeavor to illustrate and list a few of the many cases for their usefulness. In every case they effect a large saving in money, time and trouble.

WHERE THEY ARE USED

Morehead Traps are in use in the following industries:

Iron and Steel Plants, Machine Tool and Engine Builders. Ice Making and Refrigerating Plants. Dry Kilns. Sugar Refineries. Electric Light Plants. Steam Cooking Apparatus as in hotels, apartments, hospitals, etc. Tin Plate, Wire and Rolling Mills. Laundry and Dyeing Establishments. Greenhouses. Water and Gas Works. Packing Houses. Mining and Smelting Plants. Textile Mills. Government and Public Buildings. Newspapers and Printers. Lumber and Woodworking Plants. Cement Manufacturers. Soap and Chemical Manufacturers. Irrigation Plants, Breweries. Collieries, Potteries. Tanneries. Paper and Pulp Mills. Ship Builders. Leather Manufacturers. Tobacco Plants. Office Buildings. Stores, etc.

Don't let precedent and prejudice hold you in a rut so that progress turns out and goes around you.

Write us the conditions of your steam system and let us install a Trap that will best meet those conditions.

Canadian Morehead Mfg. Co., Ltd., Woodstock, Ont.

Now is the time to get your heating plant ready

Morehead Back to Boiler SYSTEM

Picks up every ounce of condensation and delivers it to the boilers at a temperature of 260 to 330 fahr.

With the Morehead Back-to-Boiler System you can heat your plant with exhaust steam and get perfect circulation without the trouble and uncertainty of air valves or pumps. In performing this service, it consumes but 1-10th the amount of steam required by a steam pump for doing the same work.

If the amount of your steam line condensation is of any volume at all, don't waste it. **Send for a "trial trap"** and see how quickly it will show savings in your coal bills, repair expenses, etc.

MOREHEAD TRAPS are being used everywhere on **Heating, Drying and Cooking propositions of every kind from straight pipe work to fan stacks and under vacuum conditions without regard to the difference in pressures between the apparatus drained and that carried on to the boiler and without regard to location of the apparatus drained, whether above or below the water line in the boiler.**

SAVES
Heat, Fuel
Time and
Labor

Morehead Tilting Return Steam Trap

Write us your conditions, and we will have our engineers study the situation in your plant, and give you some very valuable advice absolutely free.

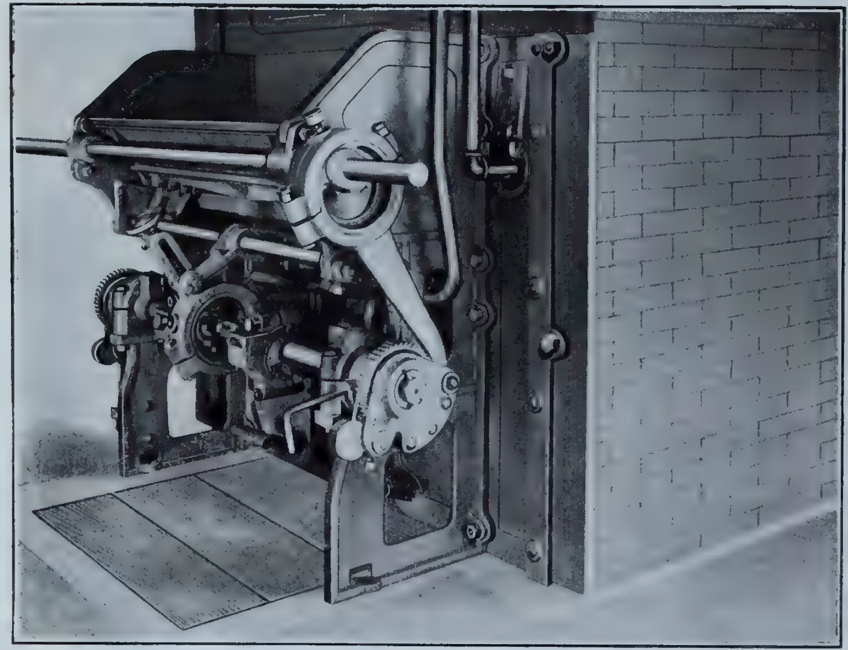
Ask for catalog.

Canadian Morehead Mfg. Co., Ltd.
WOODSTOCK, ONT.

FULTON STOKERS

EMBODY THE LATEST IDEAS IN STOKER DESIGN

50% OF ALL ORDERS RECEIVED ARE REPEAT ORDERS



Why?

BECAUSE—There is ABSOLUTELY NO SIFTING of unburned coal to the ash-pit.

BECAUSE—The annual REPAIRS are LESS THAN ONE-THIRD that of any other stoker. We guarantee free repairs for TWO YEARS. All parts in contact with the fire are WATER-COOLED.

BECAUSE—ALL KINDS OF FUEL can be burned—Anthracite, Coke dust, Bituminous slack, Lignite, Peat, or even Sawdust with excellent results.

BECAUSE—The draught requirements ARE ABOUT ONE-HALF that of any other Stoker, which means increased capacity with the same Chimney.

BECAUSE—The fire WILL NOT AVALANCHE, therefore high economy at part loads.

We also manufacture:—

The Simplex, Natural Draft, Travelling Grate.
The Monarch, High Duty, Forced Draft, Travelling Grate.
Steam Turbine Undergrate Blowers.
THECO Integrating Damper Regulators.
Complete Steam Power Plants Designed and Erected.

MANUFACTURED IN CANADA BY

THE HARE ENGINEERING COMPANY
LIMITED

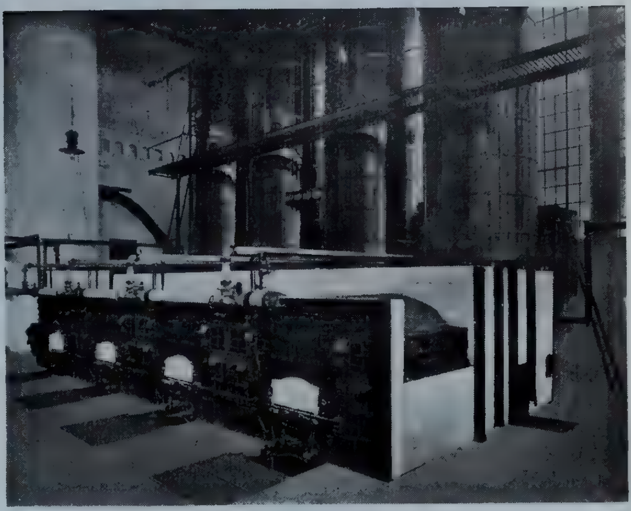
Head Office—115 King St. East, TORONTO, Ont.

—Representatives—

MONTREAL—E. Laurie Company, 243 Bleury Street.
WINNIPEG—Refrigeration & Engineering, Limited, 700 Portage Avenue.
VANCOUVER—Frank Darling & Company, 1142-1144 Homer Street.
GREAT BRITAIN—Verdon Cutts & Company, 87 Fargate, Sheffield, England.

DETROIT STOKERS

can be applied to all leading types of boilers of all sizes.



DISTINGUISHING FEATURES

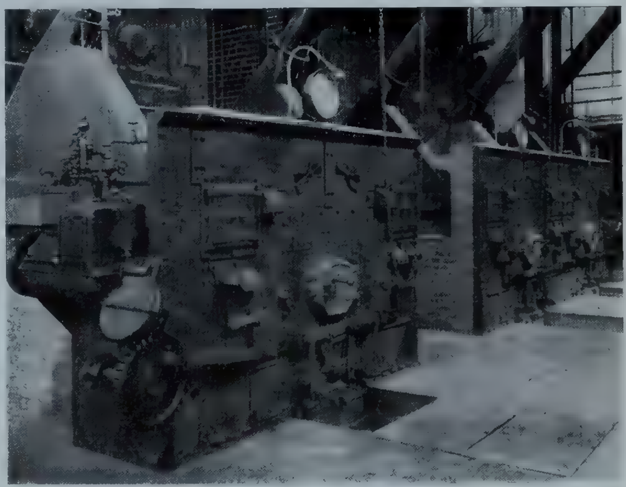
The Detroit Stoker is automatic in all its operations. It mechanically feeds and distributes the fuel and removes the ash and clinker automatically.

It has nearly twice the coking surface of any other type, obtaining perfect combustion at a slower speed.

It operates with natural draft, without the use of fans or blowers, and requires less power for operation than any stoker using a mechanical or forced draft system.

The even distribution of air, under control, over the coking coal and under the fire-brick arch, insures complete combustion and a smokeless stack.

It can be operated by hand, avoiding the necessity of shutting down the boiler or plant in case of accident.



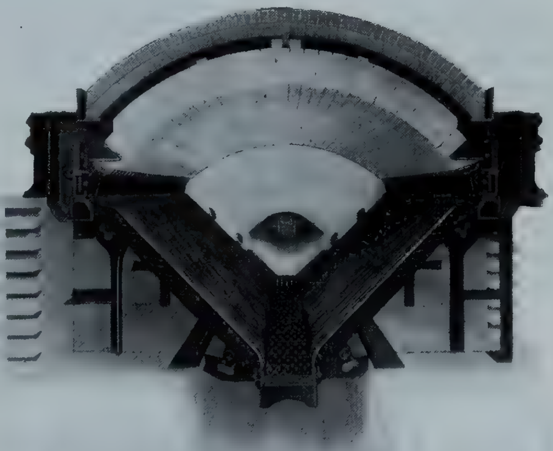
OPERATION

It is of the side feed, inclined grate type, with coal magazines on each side into which coal can be fed mechanically or by hand. As the coal leaves the magazine it becomes coked, and the volatile gases, which are driven off, become mixed with the heated air which enters through the openings directly over the coking coal, forming a combustible gas. The fuel travels slowly down the inclined grates, of which each alternate one is a vibrating grate. The movement of the vibrating grates actuates the fuel bed toward the center, where combustion is completed. The clinker crusher, having a continuous motion, grinds the clinkers and deposits the refuse in the ash-pit below.

ECONOMY AND CAPACITY

Its flexibility for variable loads and its ability to increase boiler capacity with high efficiency is important. A saving in fuel cost of from ten to twenty per cent. is obtained, and in large plants there is an additional saving in labor, as compared with hand firing.

The simple construction makes the operation easy in the hands of inexperienced labor often found in the boiler room.



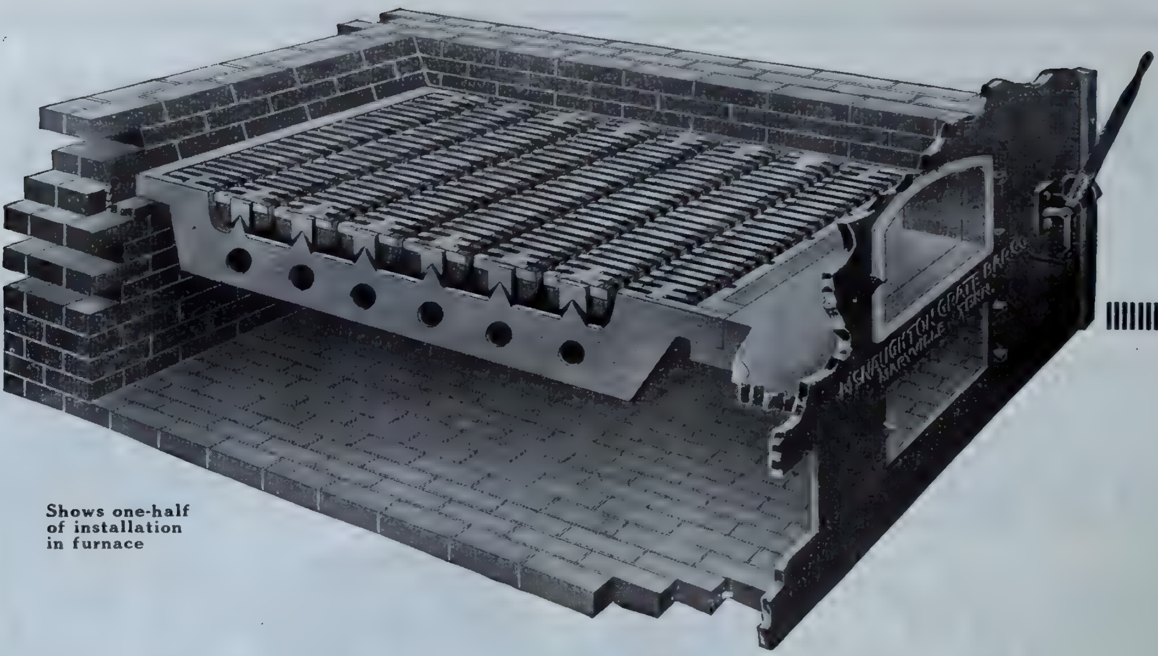
Some of our Canadian Installations:

Dunlop Tire & Rubber Goods Co., Ltd., Toronto.
Robertson Bros., Toronto.
Methodist Book & Publishing House, Toronto.
Toronto Housing Company, Ltd., Toronto.
National Acme Manufacturing Co., Montreal.
Sun Life Building, Montreal.
Brockville Light, Water & Power Dept., Brockville.
Canadian Postum Cereal Co., Windsor; also Battle Creek, Mich.

Send for our Illustrated Descriptive Catalogue.

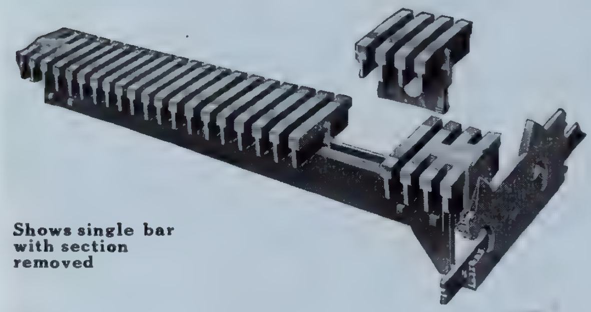
Detroit Stoker Company

DETROIT, U. S. A.



Shows one-half of installation in furnace

The McNaughton Grate



Shows single bar with section removed

The draft opening extends across the face of the whole grate

without being closed off or across any place whatever. No other grate could possibly give more draft area and leave any metal to support the fuel. None other can equal it in this respect and not have mechanical disadvantages which only this system of construction entirely overcomes.

There is room for expansion between each section, and no part of the bar is ever under any heat strain.

means a saving in fuel, through more efficient combustion, decrease in density of smoke, easier firing and considerable increase in capacity of boilers for overload.

It will, under the most severe use, stand up without sagging or buckling if given proper care. The method of construction makes repairs easy and often saves the purchase of an entire new Bar.

REDUCES COSTS OF UPKEEP FROM 50 TO 75%, AND ENABLES ONE TO ALWAYS KEEP IT IN FIRST-CLASS CONDITION.

The frame castings are substantial and heavy, connections at the corners are machined fits, turned steel pins fitting into drilled holes, positively securing all parts to places, and insures correct alignment.

The whole set of Grates and framework is self-contained, and will fit in where any ordinary grates have been removed.

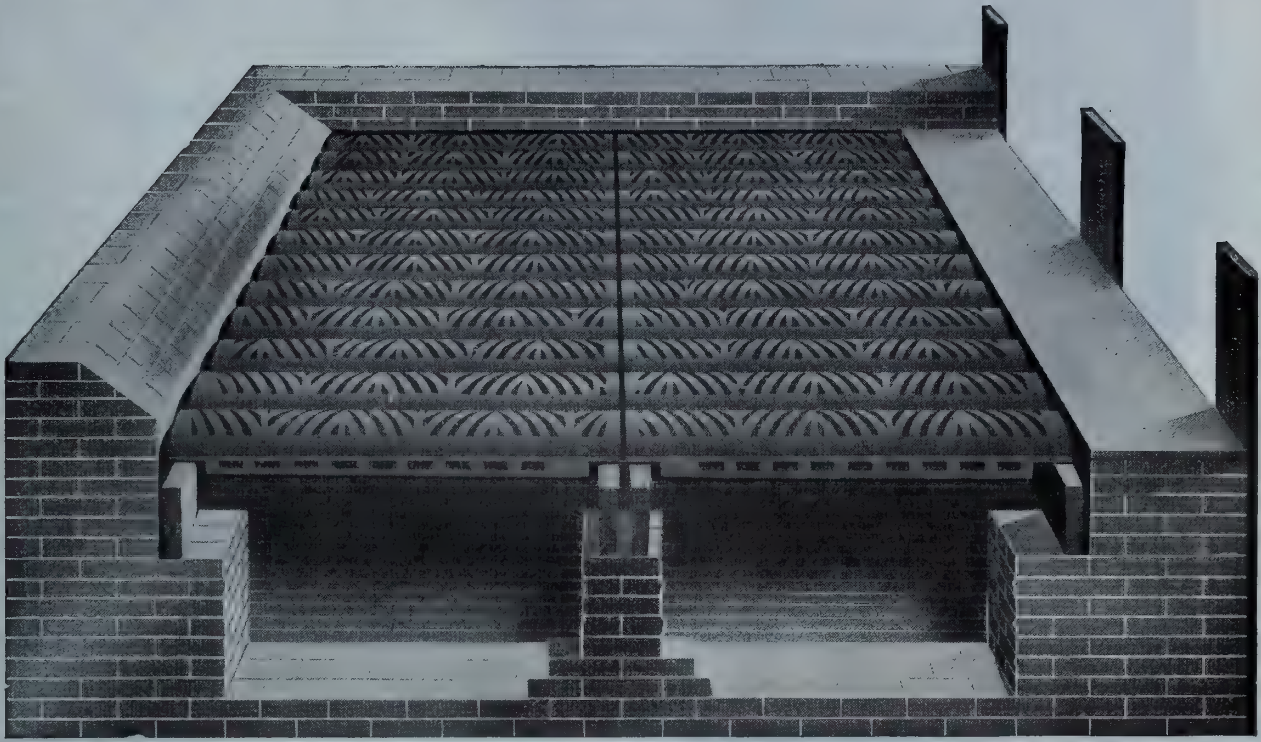
INSTALLATION ON 30 DAYS' FREE TRIAL. WRITE FOR PARTICULARS.

The Galt Foundry Company, Galt, Ont.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

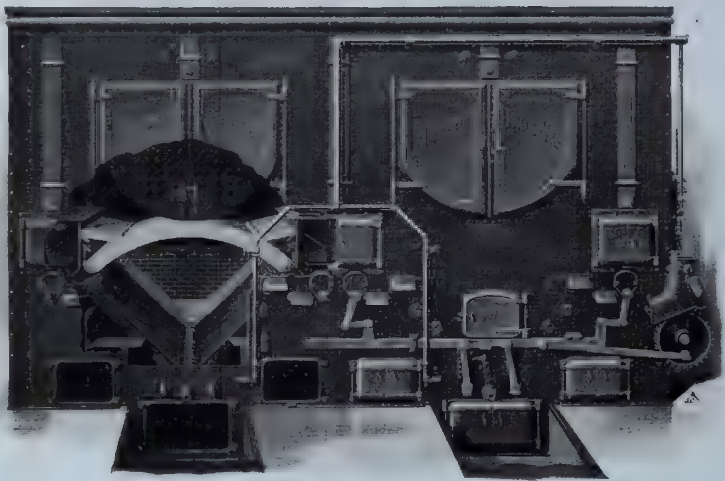
Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

Murphy Automatic Smokeless Furnaces



The first installation of Murphy Furnaces made for the Provincial Government was for 5 furnaces, in 1913, at the "ONTARIO INSTITUTE FOR THE DEAF AND DUMB," at Belleville. The results so satisfactory as, that in July we obtained contract for 4 300-H.P. units, to be installed in the new power plant at "THE HOSPITAL FOR THE INSANE," at Whitby, Ont.

NO OWNER of a steam power plant CAN AFFORD to burn coal under hand-fired conditions!

FOR LIST OF USERS AND CATALOGUE, ADDRESS

MURPHY IRON WORKS,

DETROIT, MICH.
BUFFALO, N. Y.

Upper Run of a Jeffrey Pivoted Bucket Elevator-Conveyer handling 50 tons of coal per hour.

JEFFREY COAL and ASHES HANDLING MACHINERY

is backed by Twenty-Five Years of Actual Operating Experience.

Our STANDARD Equipments have been applied to all types and sizes of Power Plants.

Send for Bulletin No. 32-A, illustrating and describing many installations.

Jeffrey Manufacturing Co.

Canadian Office, Cote and Lagauchetiere Sts.
MONTREAL

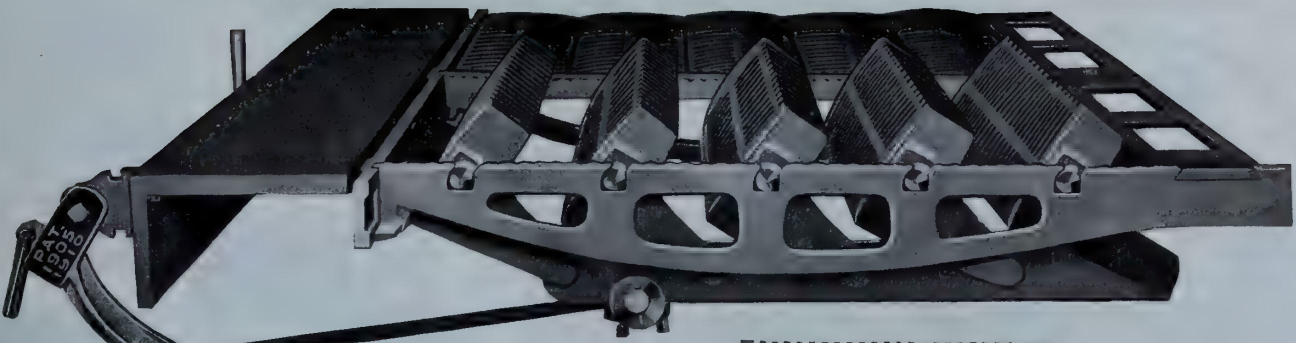
$50,000 WORTH OF

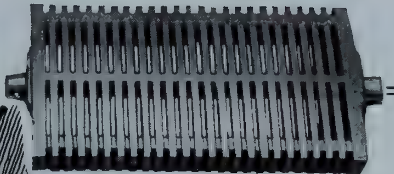
MORRIS CHAIN BLOCKS

ALWAYS IN STOCK.

THE HERBERT MORRIS CRANE & HOIST COMPANY, Limited.

EMPRESS WORKS, PETER STREET, TORONTO.





"CYCLONE"

Shaking and Dumping

GRATES

Lower Fuel Cost

We Guarantee

that with the Cyclone Shaking and Dumping Grate, any grade of hard or soft coal, or the screenings of same, can be burned with excellent results, both as regards Economy and Capacity, and that the total annual expense to the purchaser for coal, interest, depreciation, repairs, damage to boiler, liability of shut-down, etc., will be much less than will be the case with any type of Stoker or grate on the market.

The PLAN behind the CYCLONE

The plan behind the "Cyclone" is to enable the engineer to fire lightly and keep his fire free from ash, and to give the power plant owner a grate of exceptional value.

The Improved Shaking Mechanism means more vigorous and effective shaking and prevents any ashes or clinkers clinging to the centre of the grate.

The Cyclone is the one grate that locks level and cannot get out of adjustment or become warped. It has **68% air space and 90% underdraft,** which means very complete combustion.

Easily and quickly installed; no shut-down of plant is necessary. No expensive changes in brickwork needed. The perfect balance makes **operation exceedingly easy.**

The Cyclone is imitated in design, but unequalled in quality. Be sure to get the genuine, and you'll get the genuine good service.

WRITE FOR FULL PARTICULARS.

The Canadian Steam Boiler Equipment Company, Limited

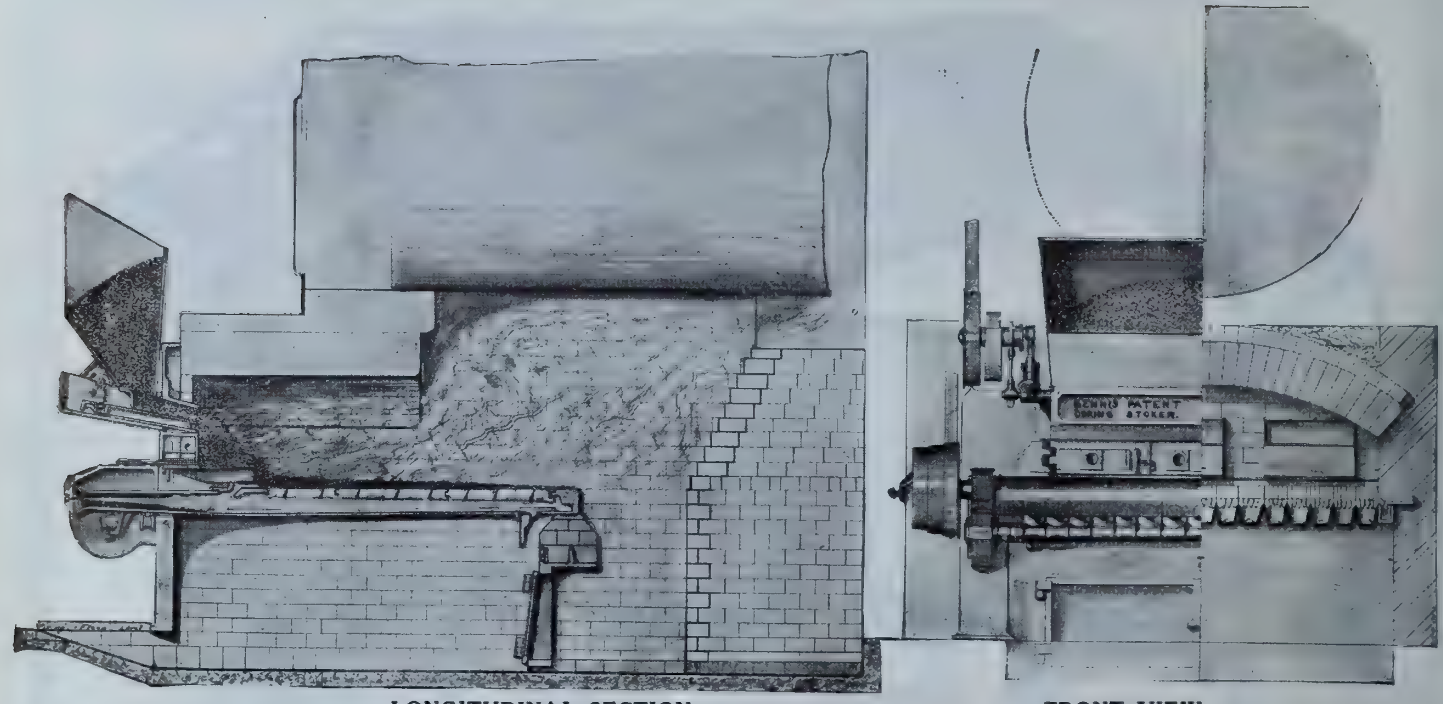
Sole Manufacturers for Canada

Phone Gerrard 3660 **20 McGee St., TORONTO**

AGENTS:—ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James street. HAMILTON, Robt. Fitzsimmons, 8 Grove street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry street. WINNIPEG, Vulcan Iron Works. PORT ARTHUR, Northern Agency Co., C. Andrews, 198 Richmond St., LONDON, Ont.

30 Days' Trial

We are prepared to install our grates in the plant of any reputable company on thirty days' trial, leaving it to the purchaser to say if the grate is, or is not, satisfactory at the end of that time. If satisfactory, we will expect payment on the terms agreed on, and if not, we will remove the grate from the premises without cost to the purchaser.



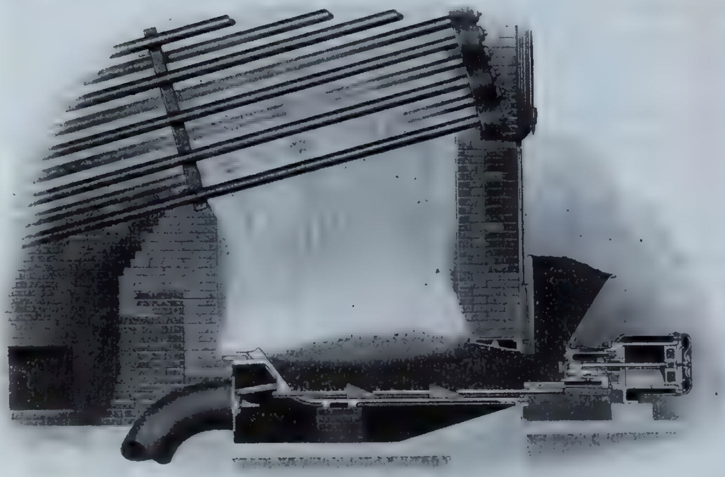
LONGITUDINAL SECTION FRONT VIEW

ARRANGEMENT OF BENNIS COKING STOKER APPLIED TO HORIZONTAL RETURN TUBE BOILER

MILLIONS OF DOLLARS are SAVED YEARLY by the USE
of BENNIS MACHINE STOKERS

WRITE FOR A FULL SET OF "BOILER HOUSE ECONOMY AND CHEAP STEAM" PAMPHLETS TO

G. H. TOD, 213 Manning Chambers, Queen St. West
Winnipeg: 601 Union Bank Building **TORONTO**



"How Can I Show Lower Operating Costs?"

Not by turning out an inferior product, which promptly "finds its level" in a reduced price!

But

By the Cheaper Production of Steam

you can "show the goods" of sterling value for less money!

It gives your whole plant a reduced operating cost!
It puts your manufactured product of standard quality on the market with increased profits.

Steam is produced from 15 to 25 per cent. cheaper by boilers equipped with Jones Underfeed Stokers, and more steam per boiler without objectionable smoke.

Jones Underfeed Stoker Company, Limited

National Trust Building, Toronto

Speeds

EVERY piece of machinery is designed to run best at a certain speed—some machines **must** be run at this certain speed.

Therefore, a knowledge of the speeds maintained is essential if efficient and economical operation is to be attained.

SCHAEFFER & BUDENBERG
AMERICAN MADE
Tachometers

measure speeds of shaftings, engines, machines, motors, turbines, etc., directly in R.P.M.

Hand Tachometer

HAND TYPE

For portable use our line of Hand Tachometers affords of a wide selection.

STATIONARY TYPE

For permanent installations there is a Stationary Type Tachometer for every conceivable requirement. The Recording Tachometer furnishes written records of speeds for every single minute, day and night.

Every S & B Tachometer is built upon the most modern principles of construction, of the finest materials and with the most expert of workmanship. Every S & B Tachometer is warranted for long life and constant accuracy

Write for pamphlets W23 and 23A.

THE
Schaeffer & Budenberg
Mfg. Company

Brooklyn, N.Y.

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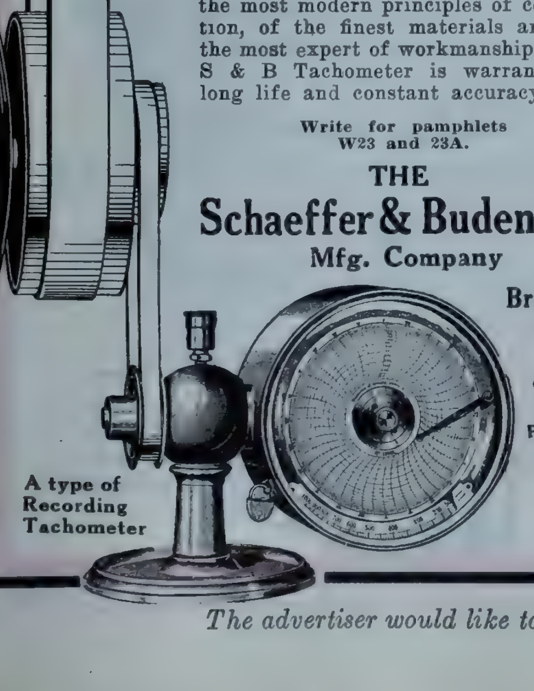
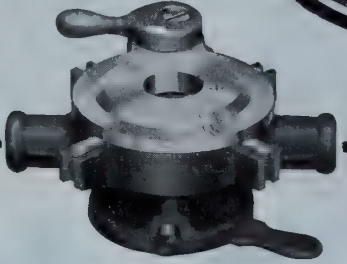


A type of Recording Tachometer

No. 82
Pipe-Threading with the Bother Left Out

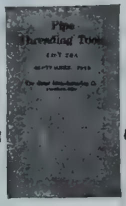


THE illustration shows the convenient Oster Bulldog Die-Stock No. 82. Note how the handy size and compact shape of this tool make it easy to handle, while the absence of loose parts and extra dies makes it easy to carry. There's no risk in ordering No. 82, because satisfaction is absolutely guaranteed in every way. The investment is small and the returns are large.

OSTER TOOLS

from the smallest to the largest of the 47 types in this group are built with extreme care and accuracy. We depend on each tool to earn for us the good-will and respect of its user. We make sure that each tool will make good. Nothing is left undone to make these tools just what the buyer expects them to be,—and a little more. A full description of every tool in the Oster group of 47 types and sizes is given in the Oster free catalog shown below. A free copy will be sent to you by return mail on receipt of your name, business and address. The coupon makes it easy. Write to-day.

The Oster Mfg. Co.
2099 East 61st Street
Cleveland, Ohio



Kindly send me by return mail complete catalog and folder on Oster Bulldog Tools.

Name ....

Business ....

Address ....

City .... State 2099

The advertiser would like to know where you saw his advertisement—tell him.

Replace the Carbon Lamp with a SUNBEAM MAZDA

Made in Canada

You'll get 3 times the light at the same cost

—a light that is very essential to high-grade workmanship and maximum output. And you'll have lamps that do not grow dim or black with age.

The fact that Sunbeam Mazda Lamps are used on street cars, fast trains, etc., where there is severe vibration, should be sufficient proof of their durability.

Send a trial order. We ship quickly and guarantee satisfaction.

The Canadian Sunbeam Lamp Co., Ltd.

Main Office and Factory
TORONTO

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MONTREAL
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TORONTO — FEDERAL ENGINEERING COMPANY LIMITED — MONTREAL

SCANDINAVIA
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BELTING

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BELTING

TEON
BELTING

*SPECIAL
HIGH
SPEED
LEATHER
BELTING.*

48 Pages

of interest and value to those who use belting for either transmission or conveying purposes.

This book will be valuable to you whether you buy from us or not. It will tell you what kinds of Belting will give you the best results for least money.

Probably an error which is most commonly made by Belting users is, when by experience, one belt is found that is superior for a particular drive it is apt to be used for all kinds of work.

In our experience we have yet to see any belt which is a universal belt. For this reason a great deal of money can be saved by using the right type of belt for the purpose required.

You will prize the information in the "Main Drive."

SEND US THIS COUPON. Slip it in an envelope or stick it to a postcard.

The Federal Engineering Co., Ltd.
TORONTO, CANADA

Please send us prepaid copy of the "MAIN DRIVE"

Name ....
Address ....
....

MAPLE LEAF

BRAND

Stitched Cotton Duck

BELTING

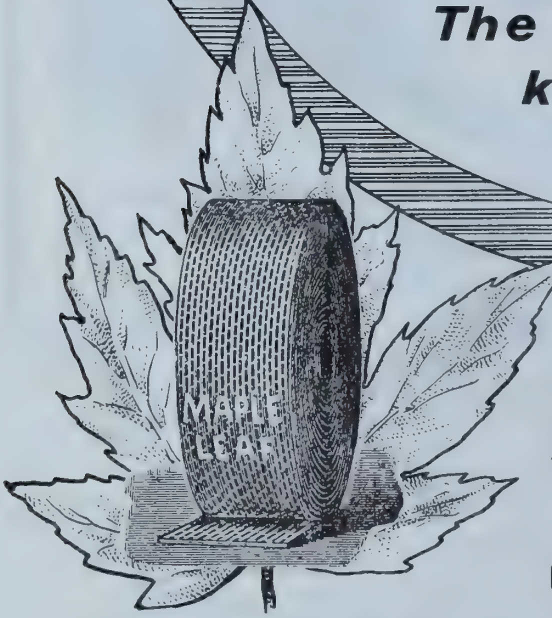
Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

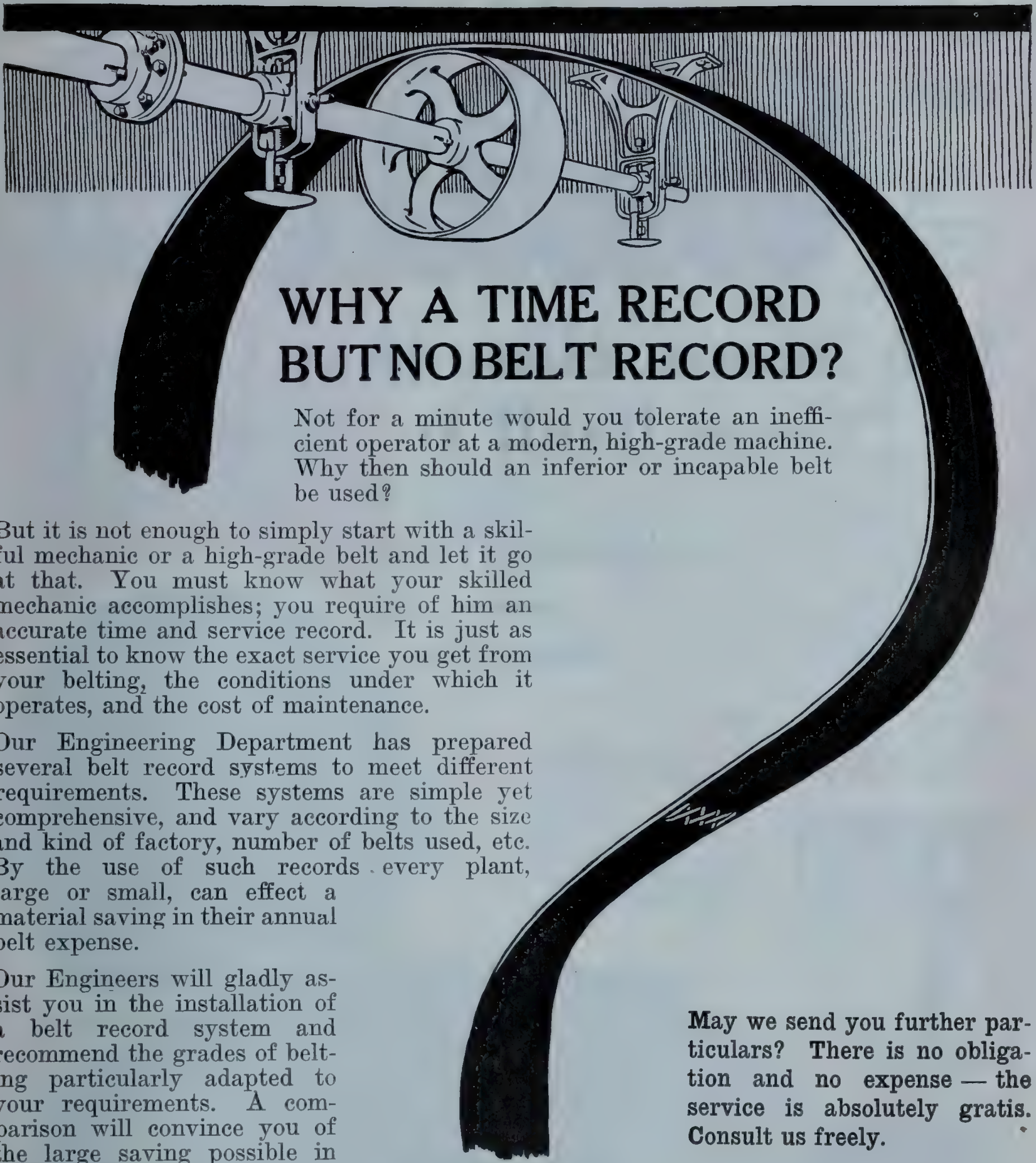
Maple Leaf Belt Dressing

The BEST for all kinds of belts



Dominion Belting Co. Limited

HAMILTON, CANADA



WHY A TIME RECORD BUT NO BELT RECORD?

Not for a minute would you tolerate an inefficient operator at a modern, high-grade machine. Why then should an inferior or incapable belt be used?

But it is not enough to simply start with a skilful mechanic or a high-grade belt and let it go at that. You must know what your skilled mechanic accomplishes; you require of him an accurate time and service record. It is just as essential to know the exact service you get from your belting, the conditions under which it operates, and the cost of maintenance.

Our Engineering Department has prepared several belt record systems to meet different requirements. These systems are simple yet comprehensive, and vary according to the size and kind of factory, number of belts used, etc. By the use of such records every plant, large or small, can effect a material saving in their annual belt expense.

Our Engineers will gladly assist you in the installation of a belt record system and recommend the grades of belting particularly adapted to your requirements. A comparison will convince you of the large saving possible in your plant by the use of our modern efficient product.

May we send you further particulars? There is no obligation and no expense — the service is absolutely gratis. Consult us freely.

The Graton & Knight Manufacturing Co.

Oak Leather Tanners and Belt Makers

1851 G&K
TRADE-MARK REG. U.S. PAT OFF

Unity Building, 46 St. Alexander St., Montreal, Que.

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1851 G&K
TRADE-MARK REG. U.S. PAT OFF

Has a Specially Compounded Heat-Resisting Lining

The Steam Hose that Doesn't "Cook Itself to Death"

GOODYEAR
MADE IN CANADA
Steam Hose

This Goodyear Hose has a specially compounded rubber lining that prevents the steam from penetrating to the fabric. It is compounded so as to be unaffected by the heat.

It is this feature that gives the wonderful durability that is winning the preference for Goodyears wherever steam hose is bought on a *service* basis.

Comes either marline jacketed or steel wire wound.

The wire winding protects the hose from rough handling. Saves it when tools and other heavy objects are dropped upon it. Adds to the wearing quality when hose is dragged about. Some prefer the marline jacketed for the comfort it affords when handled. Both styles are made to resist oil and specially adapted for intermittent pressures. Won't elongate.

Hot Water Hose

For high and low temperatures. Goodyear construction throughout. Made for rough handling.

Every Goodyear Hose, whatever its purpose, is built to meet actual service conditions. No Goodyear product is ever made to meet a price. It is this Goodyear *service* idea which eventually saves you money and equipment.

Put your hose problems up to Goodyear experts. The Goodyear Efficiency Bureau is always at your service. Costs nothing to ask questions. No obligation involved.

Goodyear Belting

Whatever the belt need there is the very Goodyear Belt for it—designed and built for the specific purpose —general transmission—main drive—small pulley—conveyor belts—elevator belts, etc., etc.

Switchboard and Dynamo Mats

Either plain or corrugated. The rubber is so carefully compounded that every mat is an absolute insulator. That's a mighty important factor where safety is so vital.

Consult Goodyear Experts

Consult the Goodyear Efficiency Bureau whenever you need belting, hose, packing or valves. If your problems are "different," that is exactly where Goodyear experts can help you. It costs nothing to consult these men. They will be glad to confer with you at any time. Their advice and counsel, cheerfully given, will save you many dollars. Buying the Goodyear way means buying once and for all.

The Goodyear Tire & Rubber Co. of Canada, Limited
Head Office, Toronto, Ont. **Factory, Bowmanville, Ont.**

Branches at VANCOUVER, EDMONTON, CALGARY, REGINA, WINNIPEG, TORONTO, HAMILTON, OTTAWA, MONTREAL, ST. JOHN, N. B.

This BIG BELT

—started work in 1878 and was replaced by a new one in 1914.

The five belts shown underneath were rebuilt from it and each is good for a minimum of 12 more years of service.

Are you getting near this kind of service from your belts?

It's upon facts like these that we base our claim that "OUR BELTING COSTS LESS PER DAY OF SERVICE."

Sadler & Haworth

Tanners and Manufacturers

For over 37 Years the Makers of the Best Leather Belts.

Montreal—511 William Street.
St. John, N.B.—89 Prince William St.
Toronto—38 Wellington St. East.
Winnipeg—Princess and Bannatyne Sts.
Vancouver, B.C.—217 Columbia Ave.

Was Made in Canada

"American" Pulleys

First all-steel pulleys ever made.

First in volume of sales.

First in esteem of users.

We have very interesting data for those who ask for it.

Dealers sell "AMERICANS"

Sizes 3" to 72" Crown and Straight—all for double belts.

Stocked and sold by dealers.

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS: Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N.B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.

The American Pulley Company, Philadelphia New York Chicago Boston

MORSE

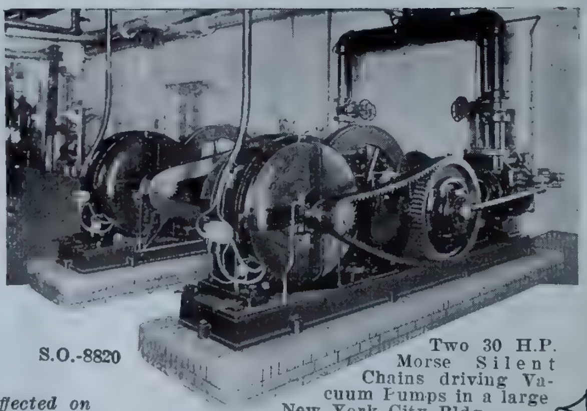
In New York

The illustration shows two 30 H.P Morse Silent Chains driving Vacuum Pumps in the Hudson Terminal Building, New York City.

Each chain is 4 in. wide by 1½ in. pitch; speed, 1280 feet per minute. Sprockets, 17 and 67 teeth; speeds, 600 to 152 r.p.m., 48 in. centers.

Further details of this installation will be furnished on request. Please refer to S. O. No. 8820.

In many public and private buildings you will also find fans, blowers, compressors, pumps, elevators, etc., driven by Morse Silent Chains—MORSE Chains being selected because of their silent action, freedom from trouble, little attention required and long life.



S.O.-8820

Two 30 H.P. Morse Silent Chains driving Vacuum Pumps in a large New York City Bldg.

Send for figures on savings effected on different machines in plants like your own. Also ask for free copy of Vest Pocket Publication No. 12.

SILENT CHAINS

Morse Chain Co. ENGINEERING DEPT., B-34 Ithaca, N.Y., U.S.A.

D. K. McLaren's Belting

will conserve your power, require less attention and give long service.

D. K. McLaren's Belting makes a splendid, hard-working belt that is adapted to any kind of drive.

The secret of the efficiency of this belting is due to the use of the best centres of carefully selected hides and the old reliable **British Oak method of tanning** — the method that gives leather wonderful strength and durability.

Practically no attention is required in service because it is true running and the stretch is taken out before the belting is sold.

The fact that many of the largest Canadian Power Houses are our steady customers should be sufficient proof of the exceptional merits.

Our OAK LEAF trade-mark guarantee is on every piece of D. K. McLaren's belting. Look for it.

It's part of our service to put you in touch with users. Why not write us now?

D·K·McLAREN
LIMITED

MONTREAL	ST. JOHN, N.B.	TORONTO	VANCOUVER
351 St. James St.	64 Prince William St.	200 King St. W.	847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. East,
WINNIPEG, MAN.

Chisholm & Moore
Hand Power

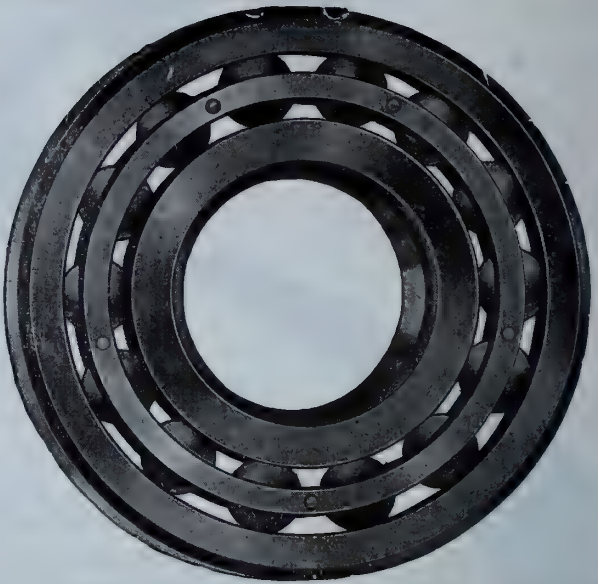
Travelling Crane Complete with
"CYCLONE" High-Speed Chain Hoist and Trolley

Handles material with a minimum of time and labor.

We are prepared to quote prices on complete installations on application, giving specifications as to length of span, capacity and distance from track rail to floor.

Hoists and Trolleys Carried in Stock.

HOFFMANN



Ball Journal Bearings

are absolutely true and uniform, both as to balls and races. Supplied with or without cages, to meet any requirements.

Roller Journal Bearings

can be supplied to replace any Ball Journal Bearing. Have 50% greater capacity for same size.

Ball Thrust Bearings

are made single and double, in any size or capacity required. Hoffman Bearings have been adopted as standard by leading engineers the world over.

Balls and Bearings carried in stock.

We carry the ONLY Stock

in Canada of

SHELBY

Seamless Steel Tubing

and are Sole Distributing Agents in the Dominion for the genuine Shelby product.

350 Sizes always in Stock

John Millen & Son, Limited
321 St. James Street, Montreal

Please send me full information about Chisholm & Moore Hoists and Trolleys—Hoffmann Bearings Shelby Seamless Steel Tubing. (Cross out lines not wanted.)

Name ....

Address ....

John Millen & Son
LIMITED

Montreal, Toronto, Winnipeg,
Vancouver, Victoria

The advertiser would like to know where you saw his advertisement—tell him.

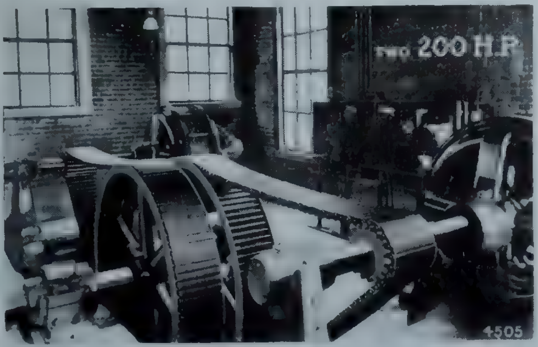
Link-Belt Silent Chain Drives

Show highest sustained efficiency of all mediums for the transmission of power—98.2% on actual test.

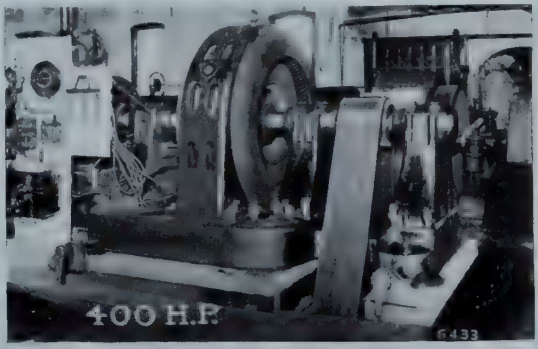
Note the Bushed Joint—it means sustained efficiency and long life.

Link-Belt Silent Chain Drives
- Can be run at relatively high speeds.
- Will run in either direction.
- Are not affected by heat, cold or moisture.
- Will transmit any amount of power.
- Give a positive velocity ratio.
- Can be used on short or long centers.
- Reduce journal friction to a minimum.
- Action remains perfect even after long use.

Link-Belt Silent Chain is the modern method of transmitting power from prime mover to machine, or from line shaft to counter shaft. It is as flexible as a belt—as positive as a gear—and more efficient than either.



Operating Line Shaft in Rubber Mill.



Line Shaft Drive in Paper Mill.

Link-Belt Engineers are experienced in solving power transmission problems, and the benefit of their knowledge should be of service to those who desire efficient power transmission equipment.

Our New Catalogue No. 125 explains Link-Belt construction fully and shows numerous typical applications. Everyone interested in the efficient and economical transmission of power should have a copy. It shows how to select silent chain drives and gives list prices. Fill out and mail the coupon below and get a copy.

John Millen & Son
LIMITED

Montreal, Toronto, Winnipeg, Vancouver, Victoria

Address all correspondence to 321 St. James Street, Montreal

John Millen & Son, Limited,
321 St. James St., Montreal.

Please send me a copy of the Link-Belt Silent Chain Data Book No. 125.

Name ....

Position ....

Address ....

The advertiser would like to know where you saw his advertisement—tell him.

TRADE MARK REG. U.S. PAT. OFF.

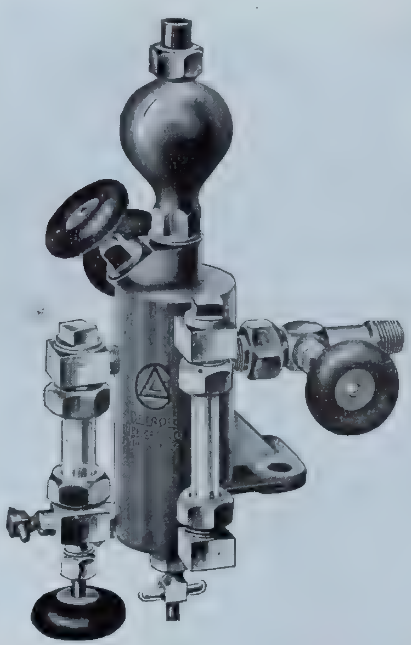
This trade-mark stands for perfect lubrication

You cannot possibly afford to take chances with your lubrication.

If the oil does not reach the **right** spot at the **right** time your power plant or machinery is going to suffer.

It is a well-known fact that more ruined machinery—more costly delays, and more expensive repair bills can be traced to imperfect lubrication than to any other one source.

Detroit Lubricators are designed to eliminate every element of chance or uncertainty from the lubrication of any kind of a machine. They are made in styles and sizes suitable for **any** kind of work, under **any** sort of conditions.



Every device we build is scientifically developed to the highest possible degree of efficiency—and for every different kind of machinery and every type of engine there is a "Detroit" that will give perfect lubrication.

You can rest assured that any lubricating device bearing the above trade-mark has been thoroughly tried out and tested under the most rigid, actual working conditions.

Yes, the above trade-mark is your insurance against trouble from imperfect lubrication—our world-wide reputation for quality product would not permit us to place this mark on any device about which there was a particle of doubt as to the actual service it would render.

The big Detroit catalog tells all about the different kinds of Detroit Lubricators and gives valuable information about the lubrication of all kinds of machinery.

Write to-day for catalog G-58

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world.

STARVED TO DEATH

MIGHT BE OUR EPITAPH

Were it not for new construction, machinery wearing out, etc., etc. We have not been in business long enough as yet to find out how long a time a Magnolia lined bearing will last—in one instance that we know about it has been running **day** and **night** on an Ice Machine Engine equivalent to 36 years, and probably is still going strong.

Seattle, Wash., Nov. 11th, 1913.

Gentlemen:—

MAGNOLIA BABBITT METAL was put in the engines of this tug when they were built, TWENTY years ago, and the bearings have **never** been rebabbitted.

Many engineers on the Sound have remarked about the wonderful wearing qualities of Magnolia Metal.

If I have occasion to use a babbitt I will surely specify Magnolia Metal.

JAS. A. HUGHES,
Chief Engineer, Tug Magic

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

This Book Tells

HOW To find the approximate Belt Speed in feet per minute.

To find the length of a belt required.

To find the horsepower that a belt will economically transmit.

To measure the length of a belt in a roll, etc., and other valuable information to any mill man.

We mail it FREE upon request. Send for a copy now.

Main Belting Company of Canada
Limited
MONTREAL TORONTO

LUBRICATING OILS

It is an acknowledged fact that our Quality First oils, grease and compounds mean an actual saving in dollars and cents.

1. **By saving your machinery through perfect lubrication.**
2. **By giving you perfect lubrication at minimum cost.**

We are the largest independent manufacturers of oils, greases and compounds in Canada.

We refer you to such concerns as the CANADA CEMENT COMPANY with branches throughout Canada; the MOND NICKEL COMPANY, Coniston, Ontario, largest nickel manufacturers in the world; the ALGOMA STEEL COMPANY, Sault Ste. Marie, Ontario, and hundreds of the largest manufacturers throughout Canada who are receiving perfect lubrication at minimum cost by using our Quality Oils.

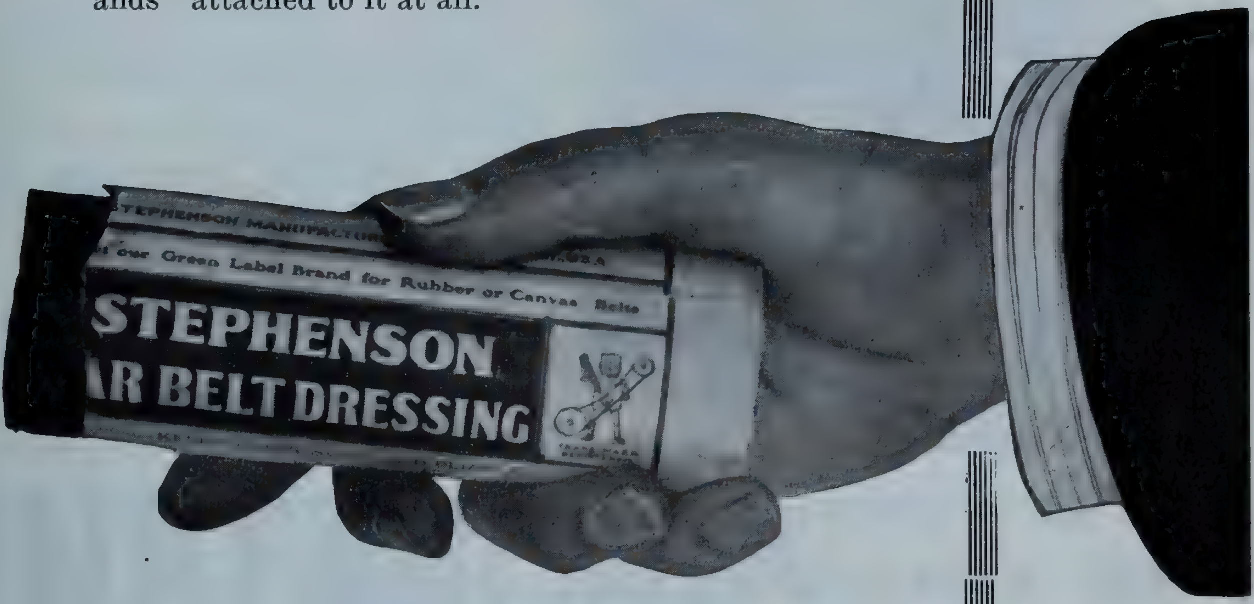
Write for a description of the Erg-Aer-Rew Atomizer which we furnish free with a positive guarantee to save you 25 per cent. in the cost of your cylinder lubrication.

Our **YUCATAN BOILER COMPOUND** will thoroughly cleanse your boilers of scale and cut your fuel bill in two.

Canadian Oil Companies, Limited
TORONTO
Montreal St. John Halifax Winnipeg Regina Calgary Nelson

We'll send this 1/2 lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.

Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me **free of charge** a half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....

PACKINGS FOR EVERY PURPOSE

The GARLOCK Line is COMPLETE

Home of QUALITY Packings

THE GARLOCK PLANT

HAMILTON, ONT.

Write Us Regarding Your Requirements

TRADE THE GARLOCK PACKING CO. GARLOCK HAMILTON CANADA MARK

Hose, Belting, Gauge Glasses, Flue Cleaners, Belt Dressings, Graphite, Waste, Etc.

Some of Our Various Styles

STEAM HIGH PRESSURE

	Style No.
Garlock High Pressure Rings	200
Garlock High Pressure Spiral	150
Garlock High Pressure Diagonal	107
Garlock High Pressure Duo	446
Garlock Valve Stem Twist	117
Garlock Derby Packing	243
Garlock High Pressure Gaskets	604
Garlock H. P. Jointing	900

STEAM LOW PRESSURE

	Style No.
Garlock Regular Rings	7
Garlock Regular Spiral	6
Garlock Valve Stem Twist	117
Garlock Red Sheet	22
Garlock Diagonal	67

STEAM MEDIUM PRESSURE

	Style No.
Garlock Rings	333
Garlock Extra Spiral	777
Garlock Duo	447
Garlock Ideal	254
Garlock Valve Stem Twist	117
Garlock Red Sheet Style	22

COLD WATER

	Style No.
Garlock Lake Brand Flax	35
Garlock Square Duck	64
Garlock Waterproof Hydraulic	92
Garlock Duo	960
Garlock Mica Frictionless	34
Garlock Red Sheet	22
Garlock Rubber Valves	175

HOT WATER

	Style No.
Garlock Special Hydraulic Rings	260
Garlock Fine Hydraulic Coil	262
Garlock Duo	1900
Garlock Red Sheet	22
Garlock High Pressure Jointing	900
Garlock Rubber Pump Valves	108

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	Style No.
Garlock Lake Brand Flax	35
Garlock Waterproof Hydraulic	92
Garlock Red Sheet	22
Garlock Black Sheet	351
Garlock High Pressure Jointing	900

ACID

	Style No.
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Garlock High Pressure Spiral	150
Garlock High Pressure Jointing	900

GAS

	Style No.
Garlock Extra Ring	333
Garlock Cushion Centre Ring	275
Garlock Red Sheet	22
Garlock High Pressure Jointing	900

OIL

	Style No.
Garlock Ideal Spiral	254
Garlock Waterproof Hydraulic	92
Garlock Oil Proof Sheet	153

GASOLINE

	Style No.
Garlock Derby	243
Garlock Duo	455
Garlock High Pressure Sheet	900
Garlock Gas Engine Sheet	165

AMMONIA

	Style No.
Garlock Extra Ring	334
Garlock Extra Sec. Ring	337
Garlock High Pressure Jointing	900
Garlock Black Sheet	351

AIR

	Style No.
Garlock Air Compressor Packing	222
Garlock Air Pump	2200
Garlock High Pressure Jointing	900
Garlock Derby Wire Insertion	248
Garlock Red Condenser Valve	152

The GARLOCK PACKING COMPANY

Hamilton, Ontario

Montreal Toronto Winnipeg Calgary

Sole Manufacturers, Garlock Packings and Pipe Coverings

MADE IN CANADA

HAVE YOU TRIED THEM?

Satisfaction to every user.

Quality better than the best you've ever bought.

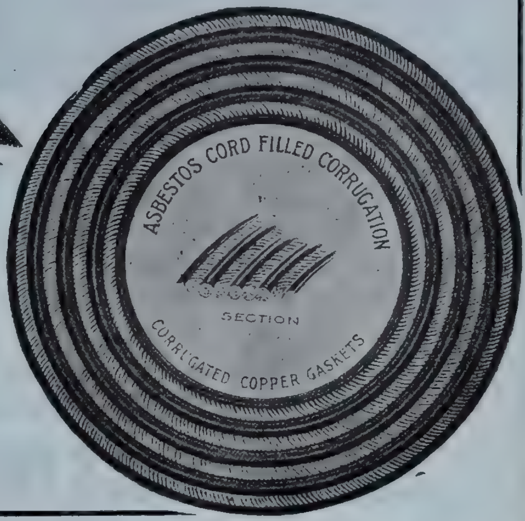
All kinds of Metal Gaskets and Boiler Gaskets.

Discounts lower than all competitors.

Shipments made same day order comes in.
(Standard sizes always on hand.)

We have repeat orders from the biggest concerns in Canada, which are our best testimonials.

SEND IN TRIAL ORDER NOW.



Canadian Gasket Company
BRIDGEBURG, ONT.

LUNKENHEIMER
CYLINDER LUBRICATORS

An exceptionally large line of Steam, Gasoline and Air Compressor Cylinder Lubricators. Hydrostatically or mechanically operated.

In addition to the above, the large and complete line of Lunkenheimer Specialties consists of **Bronze** and **Iron Body Bronze Mounted** Globe, Angle, Cross, Check, Throttle, Gate, Non-return Boiler Stop, Lever, Pop Safety, Relief, Blow-off, Screw-Down Check Valves, etc.; **"Puddled" Semi-steel** and **Cast Steel** Valves of all types; Water Columns, Gauges and other Boiler Mountings; Whistles and Ground Key Work of all descriptions; Injectors and Ejectors; Lubricating Devices; Oil Pumps, Oil and Grease Cups; Gasoline Engine Appliances, etc.

Your local dealer can furnish them; if not, write us.

A complete description of the entire line can be had by referring to Lunkenheimer No. 50 Catalogue. Write for a copy.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High-Grade
Engineering Specialties in the World

CINCINNATI, OHIO

NEW YORK CHICAGO BOSTON LONDON

22-43c

"What do you mean, blow-outs"?

"We've forgotten there was such a thing in this plant since we began to J-M **Permanite** the joints.

"What, you don't know the meaning of J-M **Permanite?**

"To J-M **Permanite** a joint simply means to pack it with

J-M PERMANITE SHEET PACKING

"And when you've done that you have a joint that simply can't blow, squeeze out, char or shrink like ordinary packings. J-M Permanite stands any pressure and any temperature.

"We don't have to work overtime any more, breaking and replacing joints. All the old trouble of following up is a thing of the past, too. J-M Permanite stays right where it is put, and does its work indefinitely.

"It won't stick to the flanges, either—and can be used over and over again on the same flange.

"They tell me it's made of long-fibred Asbestos bonded with a special heat-resisting compound.

"Yes, sir, this J-M Permanite is wonderful stuff.

"And the Company likes it as well as the men, because they've found it more economical than other packings. It outlasts them all—and being lighter in weight you get more material to the pound.

"Give it a trial on your most troublesome joint. That's what convinced us."

Write nearest branch for booklet.

THE CANADIAN
H. W. JOHNS-MANVILLE CO., LIMITED

TORONTO MONTREAL WINNIPEG VANCOUVER

2328

DURABLA

Superheat
Wet Steam

High Pressure and Oil

SOLD IN SHEETS AND GASKETS

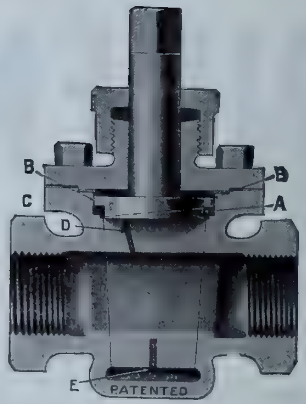
Is Sold on a Service Basis

Increases efficiency, and lowers the cost by the year.

NEVER PULPS. NEVER BLOWS OUT.

Manufactured by
DURABLA MANUFACTURING CO., NEW YORK

Canadian Sales Agents
CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, Calgary, St. John, Toronto
Saskatoon, Quebec, Winnipeg, Vancouver.



A Guaranteed Valve

For Every Purpose

Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

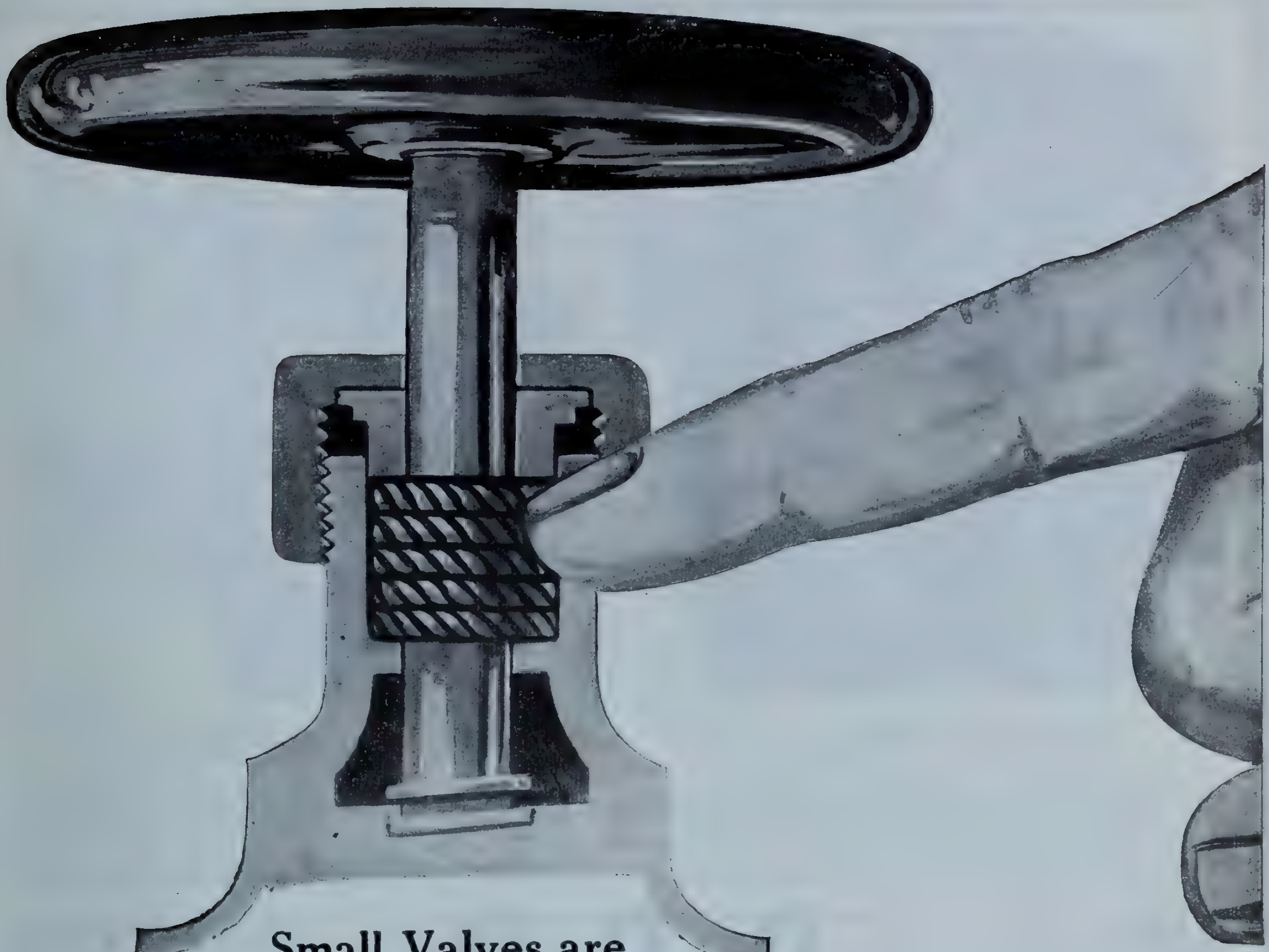
Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

Send for Catalog "R."

Homestead Valve Mfg. Co.

Works: Homestead, Pa. Pittsburgh, Pa.



Small Valves are Hard to Keep Packed

because the stuffing-boxes are small and if the packing is not the right kind it will harden and the valves leak.

TRADE-MARK

"PALMETTO" PACKING

REG. TRADE MARK

REG. U.S. PAT. OFFICE

keeps the valves from leaking, because it's made of heat-resisting materials that contain such lubricant as to keep it soft and pliable even in a small stuffing-box.

ANY SIZE VALVE PACKED FROM ONE SPOOL.

Let us send you free sample spool.

GREENE, TWEED & CO.

109 Duane Street, SOLE MANUFACTURERS **NEW YORK**

Canadian Distributing Agents, The Canadian Fairbanks-Morse Co., Ltd., Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

You DO Worry

A slick salesman sells you an imitation of P.P.P.—"something just as good." Nine o'clock finds you still in the engine room—without your supper—digging away with "packing hooks" to get out packing that has hardened and jammed around the rod till your engine labored like a winded horse going up hill. This is when you do worry.

"He Should Worry"

The "silver-tongued orator" who sold you the packing, with a big-commission profit, sits in a box at the show—after a course dinner—laughing openly at the "stunt" on the stage and chuckling "inwardly" at you and the other straightforward "boys" who thought the salesman stuck as close to the truth as you do. "He should worry."

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA.

Naturally, the aim of the manufacturer of an imitation of P.P.P. is to make money for himself—not to save trouble for you or money for your employer.

This is also true of the maker of "solid" packings, for the man with sufficient mechanical knowledge to manufacture packings ought to know that a packing that maintains a **constant** MAXIMUM bearing on the rod during the entire piston travel creates unnecessary friction during 75 to 90 per cent. of the time.

Scientific tests, made by eminent Mechanical Engineers—show that P.P.P. automatically varies the friction with the requirement, whether it be 200 pounds or but 2 pounds.

We stand ready to prove our case. Ask the other fellow to present his evidence.

We are satisfied to let you be both "judge and jury."

License Examination Book, FREE

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name ....
Address ....
Employed by ....
Address ....
Horsepower of engine ....
Kind of Rod Packing used ....
Kind of Sheet Packing used ....
Dealer's Name ....
Address ....
Name of Buyer ....
.... Series 24-J

QUAKER CITY RUBBER COMPANY

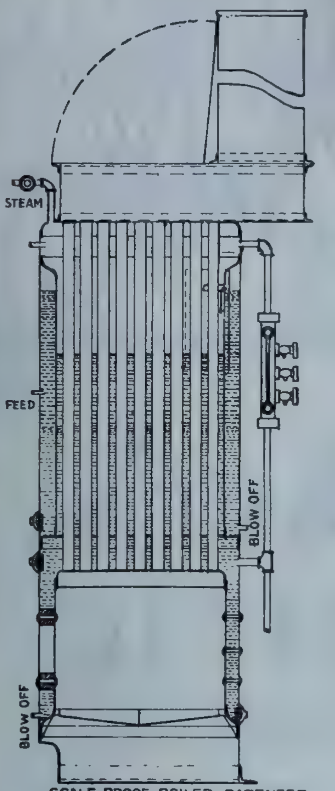
Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, Pa., U.S.A.

629 Market St.

The advertiser would like to know where you saw his advertisement—tell him.

Here's a BOILER that's fool-proof and scale-proof



SCALE PROOF BOILER, PATENTED
MADE BY
THE ALEX. McKAY BOILER WORKS,
MONTREAL, CAN.

is of the internally fired, vertical, full length tubular type and of the best design, and in addition to the usual attachmeuts, is provided with a settling chamber. This arrangement consists of a flanged ring attached to the inside of the shell above the lower tube sheet; to the inner flange of the ring a casing is attached which extends above the normal water line of the boiler, this forming an annular space between the outer shell and the casing into which the water enters. The top of said casing is set out to meet the shell to form a baffle plate, but not riveted.

Near the top of the casing on the side opposite to the feed inlet, a series of holes are punched through which the pure water (after all scale-forming material has been precipitated to the bottom of the settling chamber) overflows into the boiler proper. Over the holes, and extending both above and below same, is placed a hood, which prevents any floating substances, such as oil, etc., from entering the boiler proper.

The process is as follows: The feed water enters and fills the settling chamber to the point of overflow into the boiler. The capacity of this annular space is proportional to the size of the boiler, and is sufficient to allow the complete precipitation of all scale-forming material before the water goes to the boiler proper. While in the settling chamber its temperature is raised to that of the steam, which is usually above 300 F. The carbonates and sulphates are precipitated at 280 F. in the form of a soft sludge, which is periodically blown off at the bottom of the chamber and cannot become baked hard as it would if in contact with the fire-swept surfaces.

As a test, 20 lbs. dry earth, 20 lbs. dry slacked lime, and 10 lbs. of plaster of Paris, making a mixture like milk, was fed into the boiler, and after shutting down, all the solid matter was found in the settling chamber. A further severe test, using water from the Montreal City Water Works (in which all scale-forming matter stays in suspension until boiled) was made. This test proved conclusively that absolutely all scale-forming matter was precipitated in the settling chamber and that only pure water entered the boiler proper.

The amount of heating surface available for the superheating of steam makes same very economical.

You don't have to blow this boiler down, as is necessary in all other cases; you simply open the Settling Chamber Blow Off once a day and blow all scale-forming matter out, the boiler in meantime being under full head of steam.

There is a big saving of coal and all materials and apparatus for the treatment of water, as well as the labor of scraping out scaly boilers.

Write for further particulars.

The Alex. McKay Boiler Works
1194 Demontigny St. East, MONTREAL. QUE.

ELIMINATE SCALE **1886-1914** **STOP CORROSION AND PITTING**

28 YEARS OF SUCCESS

Thorough Tests Have Proven the Superiority

OF THE

RED STAR METHOD

For Maintaining Clean and Efficient Boilers

Difficulties arising from SCALE and GREASE accumulations, corrosion, foaming and pitting—all of which endanger, and materially increase the cost, of operating Steam Boilers have been met in every part of the country and successfully overcome; and the thousands who have been benefited through the use of the RED STAR METHOD of feed water treatment, attest the value of RED STAR PRODUCTS.

The RED STAR METHOD is *scientific* and *individual*. From the analysis of Feed Water, and incorporation of proper Chemicals in the Compound to meet each individual requirement, to the improved method of feeding—which insures best and most economical results,—the RED STAR METHOD is indisputably correct. (We loan a special feeding device to our customers without charge.)

Our claims, proven by actual demonstrations for more than a quarter century, should interest every steam user to the extent of at least asking for our Special Proposition and Guarantee. *What we have done for others we can do for you.*

LAKE ERIE MANUFACTURING COMPANY, INC.

Home Office and Factory:
192-198 Chicago Street,
BUFFALO, N.Y., U.S.A.

Canadian Representative:
Grant H. Powell, 81-85 Victoria St.
TORONTO, ONT., CANADA

The Compound that Really *does* kill Scale

15 to 25 per cent. of your Fuel is being wasted

---if your boilers have but ONE-EIGHTH inch of scale

Scale makes excessive fuel bills and more labor in firing

THE
Electric Boiler Compound Company, Limited
GUELPH, ONTARIO

Walker's Electric
Boiler Compound

will keep scale from forming if used regularly. It will not injure your boilers, fittings or pumps—it will keep your boiler at full capacity, thereby maintaining efficiency—it will prevent pitting or corrosion or other boiler troubles, due to impurities in your feed water.

Try a barrel. We guarantee satisfactory results.

We also manufacture the following

HIGH-GRADE OILS

Regal Valve Oil, Red Star Cylinder Oil, Monarch Cylinder Oil, Heavy Red Machine Oil, Superior Engine Oil, Electric Engine Oil, Brush Dynamo Oil, Anti-Carbon Auto Oil.

We have the goods—it's up to you.

Did You Know This

Perolin

is not a "Boiler Compound" in the general meaning of the term — because it has no chemical action whatever upon the water or scale.

PEROLIN IS A METAL TREATMENT

and when introduced into the boiler is drawn to the metal and **mechanically breaks the bond of adhesion** between the scale and the metal. It then establishes a "Perolin Preservative Film" on the metal, which has a high conductivity of heat, and this Perolin Film repels all precipitated scale-forming sediments, preventing any further scale formation. This sediment is removed each day through the blow-off pipe.

Perolin does not treat the water. The water is always changing—so there is nothing definite about that—Perolin treats the boiler metal—it is everywhere and always the same.

DURING THE LAST FOUR YEARS PEROLIN HAS WON PLACE BY ITS MERITS IN OVER 30,000 PLANTS IN CANADA, UNITED STATES AND MEXICO.

We'll ship you, freight prepaid, a sufficient quantity to test for sixty days.

If not satisfied with the results, return what you have left, and the amount used will cost you nothing.

Our Guarantee

We guarantee PEROLIN, the Boiler Metal Treatment.

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

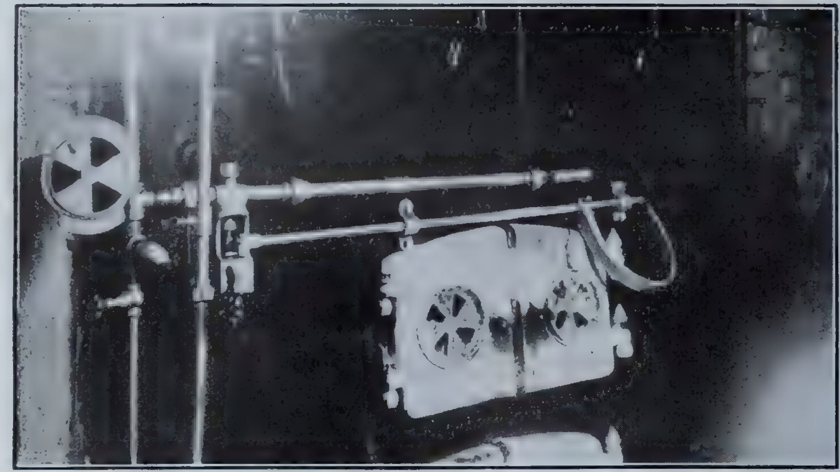
Perolin Company of Canada, Ltd.

76 Adelaide St. West Toronto, Ont.

Quebec Agents: Burroughs, Joyce & Co., 30 St. John St., Montreal, Que. **Manitoba and Northern Ontario Agents:** Engineering & General Supply Co., Ltd., 206 Nanton Bldg., Winnipeg, Man. **Alberta Agents:** The Western Supply & Equipment Co., Ltd., Calgary, Edmonton and Lethbridge, Alta. **British Columbia and Yukon Agents:** Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

GIBBONS-KEMP

Oxygen Fuel System

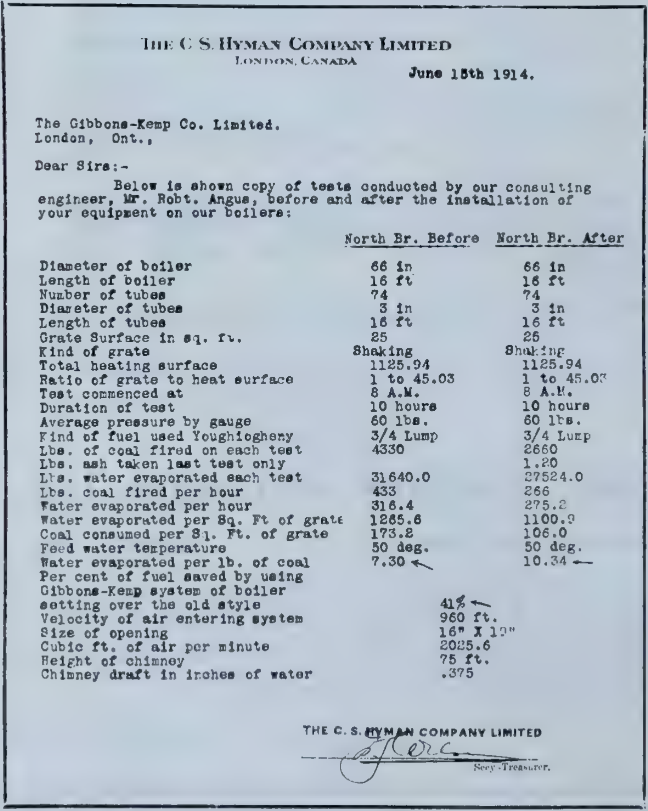


Consists of a series of coned devices built into the side walls, bridge wall and front of boiler setting. The object is to mingle heated oxygen with the gases, when liberated from the fuel, and by so doing we get perfect combustion. A current of air is taken from the front of the boiler and passes along the coned side devices three times before it is delivered to the fire.

A current of air is also passed into a coned device placed within the bridge wall. Also a small steam jet, taking about one per cent. of the boiler capacity, is passed through the superheater, placed in front of the boiler setting, and is used only as a force for the purpose of mingling the oxygen with the carbon gases during firing.

An automatic valve, as shown in cut, is used to control the steam jet, which opens when the fire door is opened, and closes from thirty seconds to five minutes after the door is closed, and can be timed to suit the quality of coal used. Pre-heated air is used for draft, effecting the same economical results as the feeding of heated water in place of cold to the boiler. All heat used for pre-heating the oxygen and draft is waste heat, and therefore takes nothing from the efficiency of the boiler.

No force draft is used—the whole system being perfectly automatic, and although an intense heat is generated, it is distributed evenly over the full length of the boiler. No machinery is used in this installation, so there is nothing to get out of order to cause expensive repairs. The first cost is the only cost, and provided the fire lining is kept in repair, which has to be done in any case, our installation will last the life of the boiler.



THE C. S. HYMAN COMPANY LIMITED
LONDON, CANADA

June 15th 1914.

The Gibbons-Kemp Co. Limited.
London, Ont.,

Dear Sirs:-

Below is shown copy of tests conducted by our consulting engineer, Mr. Robt. Angus, before and after the installation of your equipment on our boilers:

	North Br. Before	North Br. After
Diameter of boiler	66 in	66 in
Length of boiler	16 ft	16 ft
Number of tubes	74	74
Diameter of tubes	3 in	3 in
Length of tubes	16 ft	16 ft
Grate Surface in sq. ft.	25	25
Kind of grate	Shaking	Shaking
Total heating surface	1125.94	1125.94
Ratio of grate to heat surface	1 to 45.03	1 to 45.03
Test commenced at	8 A.M.	8 A.M.
Duration of test	10 hours	10 hours
Average pressure by gauge	60 lbs.	60 lbs.
Kind of fuel used Youghiogheny	3/4 Lump	3/4 Lump
Lbs. of coal fired on each test	4330	2660
Lbs. ash taken last test only		1.20
Lbs. water evaporated each test	31640.0	27524.0
Lbs. coal fired per hour	433	266
Water evaporated per hour	316.4	275.2
Water evaporated per Sq. Ft of grate	1265.6	1100.9
Coal consumed per Sq. Ft. of grate	173.2	106.0
Feed water temperature	50 deg.	50 deg.
Water evaporated per lb. of coal	7.30 ←	10.34 ←
Per cent of fuel saved by using Gibbons-Kemp system of boiler setting over the old style	41% ←	
Velocity of air entering system	960 ft.	
Size of opening	16" X 13"	
Cubic ft. of air per minute	2025.6	
Height of chimney	75 ft.	
Chimney draft in inches of water	.375	

THE C. S. HYMAN COMPANY LIMITED

Secy.-Treasurer.

This is the only system whereby you will get full 80% efficiency from your coal.

We guarantee a 15% saving in fuel, regardless of the quality of fuel, or whether it be coal, coke or wood, and guarantee to eliminate the smoke nuisance. If we do not produce these results we ask no pay.

Opposite is a reproduced report of an unbiased test made by C. S. Hyman Co., Limited, of London, Ont., after our installation was made.

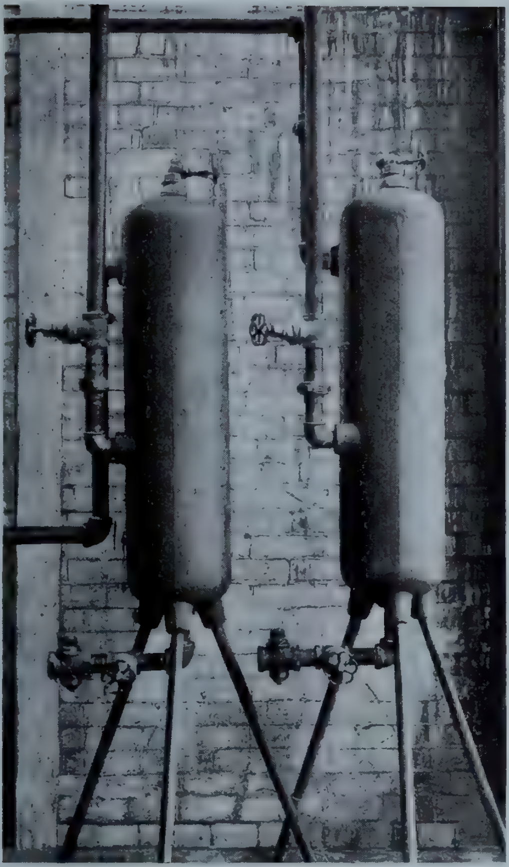
Further particulars and list of other plants equipped, with copies of boiler tests, on request.

Gibbons-Kemp Co.

LIMITED

15 Greene Swift Building,
London, Ont.

Branch Office: 53 Yonge St., Toronto, Ont.



Two Carter Filters Attached to two H.R.T. Boilers.

To All Boiler Users

THE CARTER AUTOMATIC BOILER FILTER AND CLEANER

(Patented and Made in Canada)

Will absolutely prevent Foaming, and the formation of Scale and Mud in your Boiler. Keep it clean, therefore prolonging its life, save its cost in a short time in fuel, lubricating oils, and time spent for repairs and cleaning out boiler.

Not a Chemical, but a Mechanical Device.

COSTS NOTHING TO OPERATE

Sold Only With a Guarantee ☛

What one of the users of the "Carter" has to say :

R. Forbes Company, Limited,
Manufacturers of
Woolen and Worsted Goods
Hespeler, Ont.

Dear Sirs:

This is to certify that after using three of your Automatic Mud Extractors for the past year, we have been quite well satisfied with them, and would ask you to supply four more for the balance of our boilers.

Yours truly,
R. Forbes Co., Limited.

GUARANTEE

The CARTER AUTOMATIC BOILER FILTER and CLEANER is absolutely guaranteed to prevent the formation of scale and foaming and to keep practically all the mud removed from the boiler if operated according to instructions.
If it does not accomplish what we claim for it, after being in operation for one year, we will refund the price paid for it on 30 days' notice.

Write Us for a list of some of the users and copies of their letters.

THE SIEMON COMPANY, Limited
309-11 Confederation Life Building, Toronto, Ont.

ESTABLISHED IN 1902

Engine Packings, Steam, Hot and Cold Water Packings. "Fermatite" Sheet Packing, Etc.

MAGIC
TRADE MARK

Asbestos Products, Roofing and Waterproofing. Electrical Supplies Etc.

"MAGIC" BOILER PRESERVATIVE

The First and Only Successful Iron Treatment

"MAGIC" WILL

Remove Scale already formed,
Prevent further formation,
Remove oil and grease,
Stop Pitting and Corrosion,
Stop Minor Leaks, and
Will increase the life and efficiency of Boilers and give 50-200 per cent. more service from each set of Tubes.

"MAGIC" WILL NOT

injure the metal in your boilers or connecting parts,
Evaporate from the boilers or pass over with the steam,
Affect the Packing, Lubricants, or Product which may come in contact with the steam.
Cause your Boilers to foam.

Magic Boiler Preservative is Absolutely Guaranteed

TRY IT AT OUR EXPENSE !

THE S. L. DAVIS COMPANY
LONDON CANADA

EXACT KNOWLEDGE vs. GUESSWORK
Where Do You Stand?

All Modern Experience Points to the Absolute Necessity of Scientific Treatment of Boiler Feed Waters

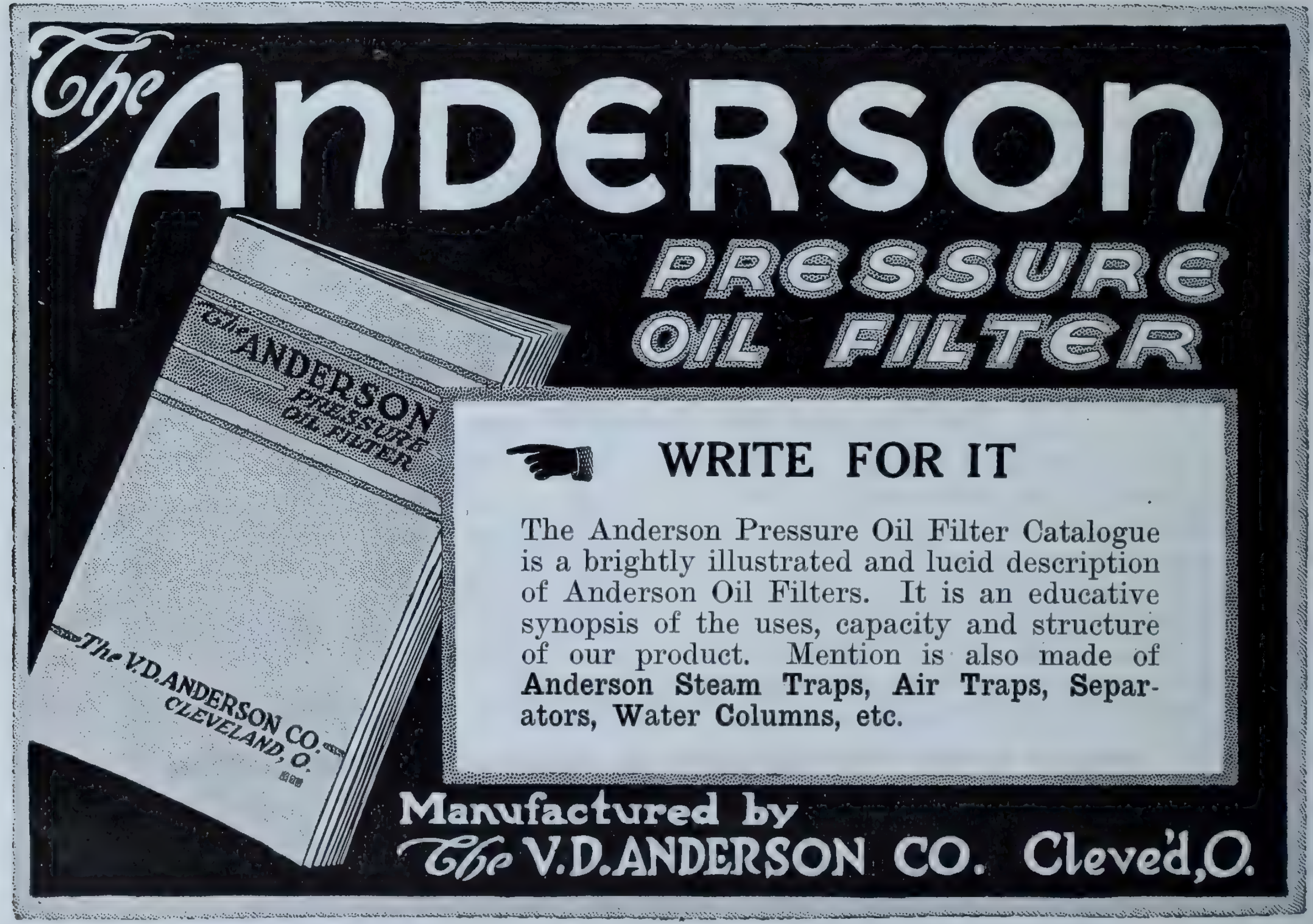
Dearborn Treatment, by its remarkable results, has convinced the industrial world that the remedy for boiler feed water troubles lies in scientific analysis and special treatment for each individual case.

Dearborn Treatment is to ordinary "boiler compounds" what eminent, scientific diagnosis and prescription is to quack nostrums and "cure-alls."

Dearborn Treatment is based upon an expert, scientific analysis of a sample of the boiler feed water you are using. The analysis, tests and compounding of the correct remedy are conducted in the largest, most modern and elaborately equipped laboratories and manufacturing plant devoted to the science of water treatment in existence.

Dearborn Treatment gives you the benefit of the world's largest existing fund of data and experience relating to water treatment.

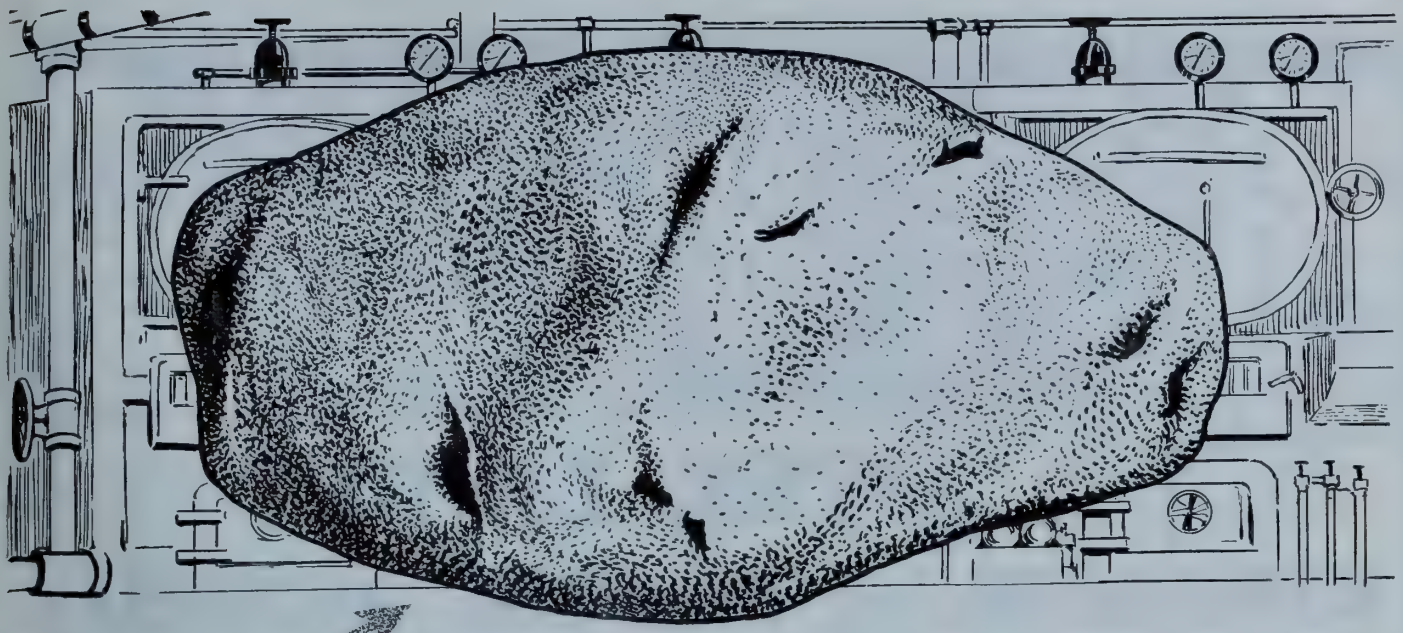
Dearborn Chemical Company of Canada, Limited
General Offices, Laboratory and Works, 1220-1230 Dundas St., Toronto, Ont.



WRITE FOR IT

The Anderson Pressure Oil Filter Catalogue is a brightly illustrated and lucid description of Anderson Oil Filters. It is an educative synopsis of the uses, capacity and structure of our product. Mention is also made of **Anderson Steam Traps, Air Traps, Separators, Water Columns, etc.**

Manufactured by
The V.D.ANDERSON CO. Cleve'd,O.



Potato Scale Boiler Compound

Adds new life to boilers and saves fuel

It stands to reason that boilers with a coating of scale on the tubes must require more fuel because scale (like rock) is a very poor conductor of heat.

1/16 of an inch of scale means an increase of about 15% in fuel bills. Perhaps your boilers are **more** badly scaled—investigate!

Potato Scale Boiler Compound is a thorough eradicator and preventative of the scale troubles. It soon removes old scale, and, if a small quantity is used daily in the feed water, no new scale will form, and there will **be no boiler troubles such as pitting, corrosion, foaming, etc.,** due to impurity in the feed water.

We exercise great care in preparing this compound—nothing enters into it that is at all destructive to metal.

We make it to suit feed water conditions, and guarantee satisfactory results.

May we submit references and full particulars?

THOUSANDS ARE USING IT. WHY NOT YOU?

C. C. SNOWDON

1810-1840 11th St., Calgary, Alberta—P.O. Box 1384

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid-Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Branches:—Edmonton, Winnipeg, Vancouver

"THE LINDE"

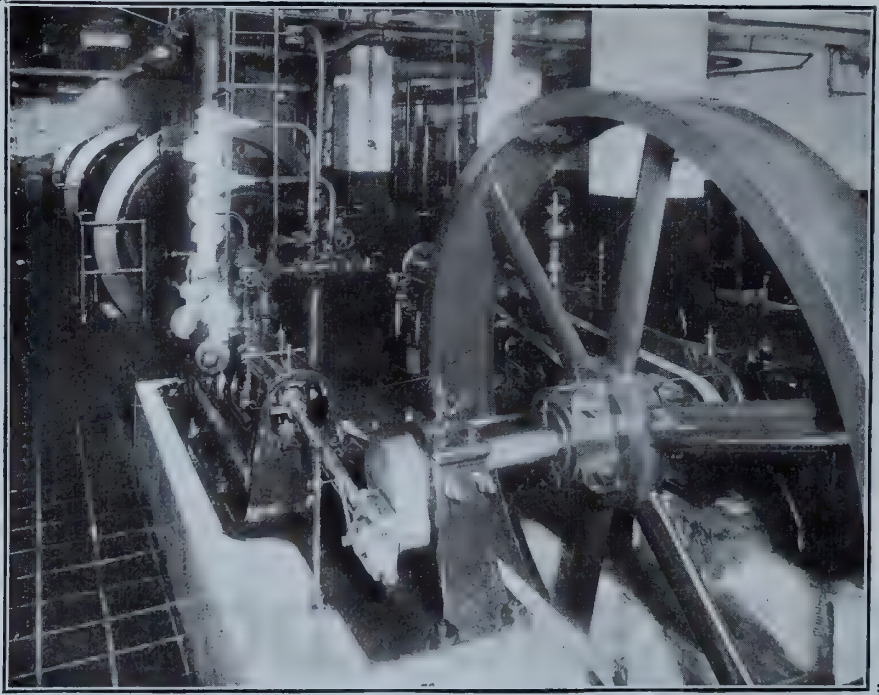
REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Plants installed complete, including Cork Insulation, any size and for every purpose.

A complete line of Ammonia fittings and spare machine parts always carried in stock.

New refrigeration plant in Power House of Hudson's Bay Company Store, Calgary, installed by us.



Over 8,000 Machines in Use.

Overhauls and repairs by competent engineers.

Catalogs and estimates upon request.

Established and Manufacturing in Canada for 18 years.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL

Branch Offices—Toronto, 28 Front St. East; Winnipeg, 909½ Main St.; Vancouver, 42 Inns of Court Building; Edmonton, Walker & Barnes, 562 Second Street; Calgary, 320 P. Burns Building.

THE H&C SAFETY

The Largest Ice Dealer in Detroit Installed Two H. & C. Safetys a Year Ago.

Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of **6 3-10 K.W. per ton or more than 11½% saving in power consumption.**

You, Mr. Iceman, should check up on your costs and capacity against these records.

Write us to-day for a Pittmans & Dean chart of their year's results.

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Refrigerating and Ice-Making Machinery
DETROIT 42nd Year. **MICHIGAN**

Worth Your Study

ARCTIC ICE MACHINERY

The Ammonia Compressor guaranteed to produce 20% over-capacity as compared with any other Horizontal ice machine of equal size on earth—it's a mighty interesting proposition. Bulletin 1-P explains the construction.

ARCTIC-POWNALL RAW WATER ICE PLANTS

Are causing orders and inquiries from all parts of the world—and the sparkling purity and freedom from taste or odor of this ice deserve the popularity it has achieved. Ask for full particulars.

"WE DO IT RIGHT."

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration.

De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

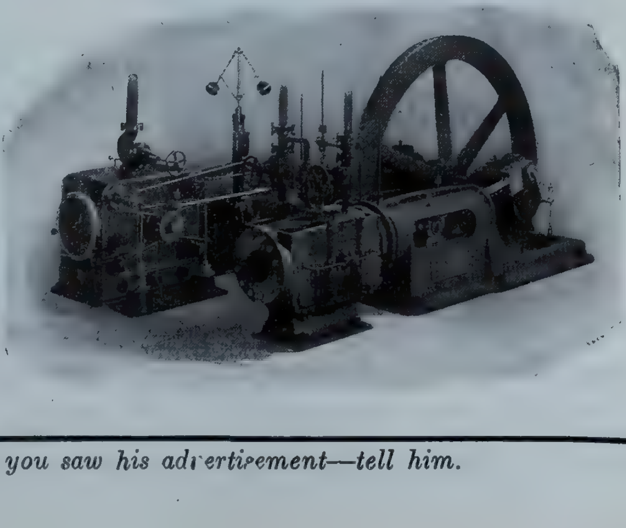
The name De La Vergne stands for highest quality, maximum capacity, absolute reliability and permanent economy.

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada



Plant of the York Manufacturing Co.

Devoted exclusively to the manufacture of Ice-Making and Refrigerating Machinery and Supplies.

The World's Largest Ice Machine Plant

IN AREA—over 15 acres in extent.
IN OUTPUT—647 YORK Machines, having a total refrigerating capacity of 13,645 tons per 24 hours, were shipped in 1913.
IN NUMBER OF EMPLOYEES—over 2,000 men are employed in the manufacture, sale, and in superintending the erection of YORK products.

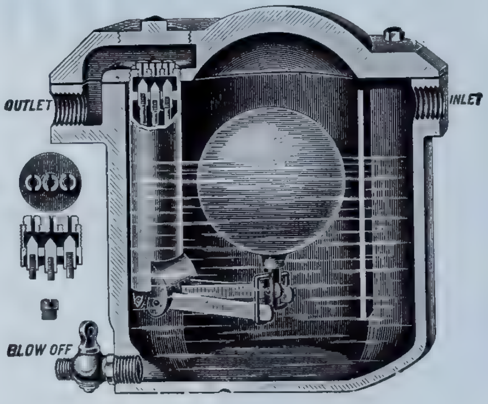
Consult us in regard to your Refrigerating Requirements.

York Manufacturing Company, York, Pa., U.S.A.

Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

MONTREAL, 324 Coristine Building **TORONTO, 163-167 Yonge Street** **WINNIPEG, 302 Donalda Building**



Wright "Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.

Shipped subject to trial and return if results are not satisfactory.

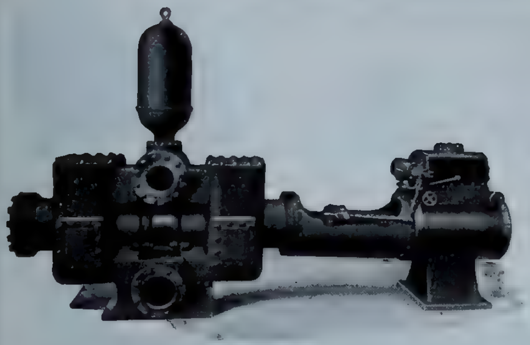
Send for Catalog.

DARLING BROS., Limited

15 Ottawa Street, MONTREAL

TORONTO **WINNIPEG** **ST. JOHN, N.B.**

Built-in Merit



American Outside Center Packed Plunger Pump

CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman Machinery Co., Vancouver, B.C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.

MARSH and AMERICAN PUMPS

have the qualities built in which insure long service, for instance, the water end is equipped with a heavy cast bronze removable liner which may be rebored several times. The piston rods are of solid bronze and are oversized. The steam and water cylinders are connected by heavy cast iron cradle yokes instead of tie rods.

Notice the heavy, rugged construction and the extreme simplicity of the steam end.

Marsh and American Pumps are guaranteed to operate on at least 25% less steam than any duplex pump on the market. Ask us for copies of test sheets proving this statement.

Ask for new Bulletin Catalog No. 19-PH

Marsh Deep Well Engine

American Steam Pump Company, **BATTLE CREEK, MICH.**

Manufacturers of Marsh and American Steam and Power Driven Pumps and Air Compressors

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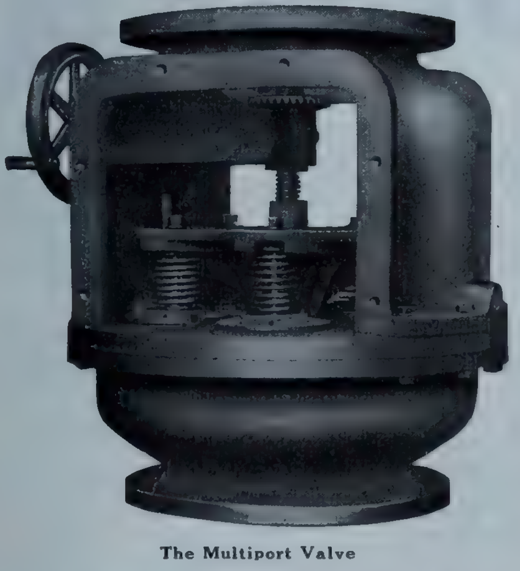
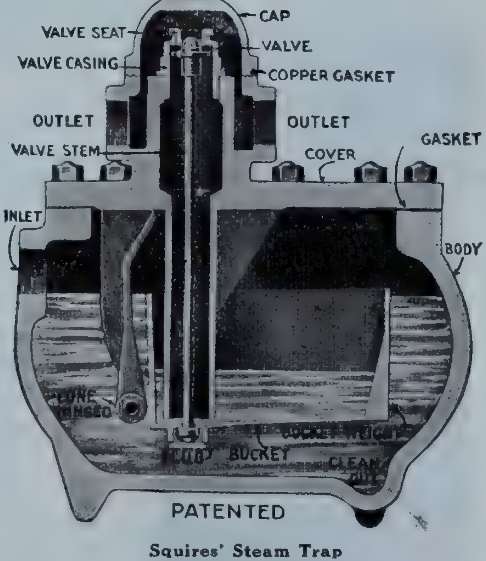
POWER HOUSE SPECIALTIES



The Multiport Valve

Is your back-pressure valve safe? With a **Cochrane Multiport Valve** the back pressure can be varied as often as you like. The Cochrane Multiport cannot be over-weighted or tied down or jammed.

The Squires Improved Steam Trap is distinguished by great capacity, durability and efficiency, low cost of maintenance and few working parts.



Squires' Steam Trap

CANADIAN ALLIS-CHALMERS, LIMITED

HEAD OFFICE, KING and SIMCOE STREETS, TORONTO

District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

USE THE BEST

ANHYDROUS AMMONIA
"EXCELSIOR" BRAND

100% EFFICIENCY

MANUFACTURED ONLY BY

Canadian Ammonia Co., Ltd.

TORONTO, ONT. DETROIT, MICH.

STOCK CARRIED IN ALL
PRINCIPAL CITIES IN CANADA

McDANIEL IMPROVED **STEAM TRAP**

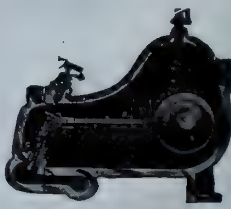
FOR HIGH OR LOW PRESSURE.

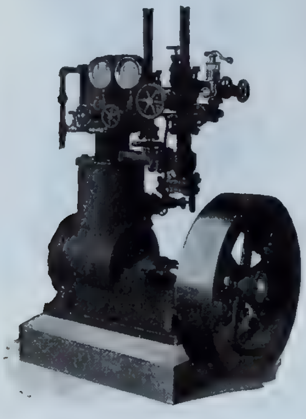
Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.





Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive.

Ice Making and **Refrigerating Machinery**

Established 1867

Built in any capacity that you desire.

Our small machines have the same "Regularity of Operation," "Reliability" and "Efficiency" as our large ones.

Write us concerning the size you wish.

The Vilter Mfg. Co.

242 Becher Street,
Milwaukee, Wis.
Chicago Office: 731 Monadnock Bldg.

J. V. Jamison, Pres. T. B. South, Vice-Pres. J. V. Jamison, Jr., Sec. & Treas. R. L. Jamison, Order & Ship. Dep't.

Cold Storage and Freezer Doors either Standard or Fireproof **DOORS**

The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones'." Built for strength and durability.

We have a 68-page profusely illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

The "Jones" Cold Storage Window.
The "Jones" Automatic Ice Recording Doors and Chutes.
The "Jones" Platform Ice Passing Chute and Door combined.
The "Noequal" All Steel Automatic Ice Chute.
The "Noequal" Revolving Ice Cream Passing Door (Wood or Steel)
The "Jones" Vertical Sliding Door.

JAMISON COLD STORAGE DOOR CO.
FORMERLY
JONES COLD STORE DOOR CO.
HAGERSTOWN - MARYLAND, U.S.A.

"Jones" Standard Automatic Track Door, Left Hand.

"Peiler" Quality and Service

Mean efficiency and economy

It is not what you pay for an article, but what the article pays for in return for its cost that determines its real value.

It is part of our service to send expert engineers to help prospective customers get the goods that will give them the best results, economically.

If you incur difficulties in any form of pressure and temperature control, Heaters, Condensers (steam and ammonia), Shaking Grates, Special Engine and Ammonia Packings, etc., write us. Our experts will come to your assistance at once.

H. L. PEILER & CO.

44 Colborne St.
Toronto, Ont.

380 St. James St.
Montreal, P. Que.

The New "Bundy" Steam Trap

maintains the same general principle in the construction and mechanism that has stood the test for so many years, improving some of the detailed parts so that we have in our new trap PERFECTION.

While the old "Bundy" was exceedingly popular and efficient, we have found a way to make it still more so by eliminating the only objectionable feature, the trunnion joint. The new "Bundy" is absolutely water and steam tight under all conditions, and REQUIRES NO ATTENTION from the engineer.

The new "Bundy," both high and low pressure, size for size, will handle a larger volume of water per hour under given conditions than any other trap made.

OUR CIRCULAR WILL GIVE YOU FULL PARTICULARS. WHY NOT DROP A CARD FOR IT?

"Mason" Reducing Valves

are always **RELIABLE.**

Mason's All-Bronze Standard Valves reduce steam or air pressure from 300 lbs. or under down to any desired low pressure. And the Mason Standard Reducing Valve is exactly similar in construction except that the large diaphragm is sufficiently sensitive for use under the lowest pressures, **EVEN BELOW the ATMOSPHERIC PRESSURE.**

Write us for free illustrated circulars showing the unbeatable Mason line of Regulators, Reducing Valves, etc.

Genuine "Ashton" Valves

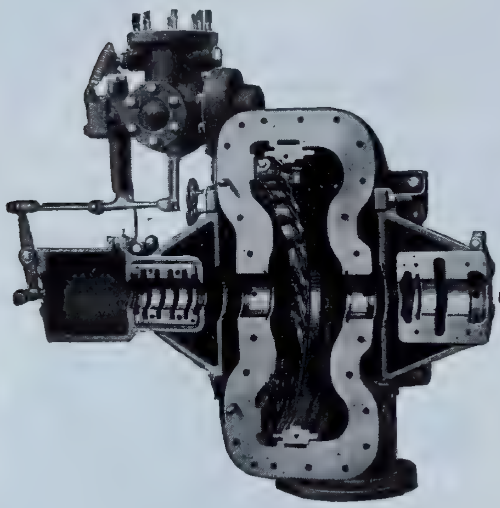
are the World's Standard.

Wherever steam power is used you will find Ashton Valves giving active and entirely satisfactory service. Being perfectly automatic in operation, simple in design and construction, and having no parts liable to accidental derangement, they are unquestionably the most reliable safety valves made. And they save steam-waste, too, by means of the "pop" chamber feature.

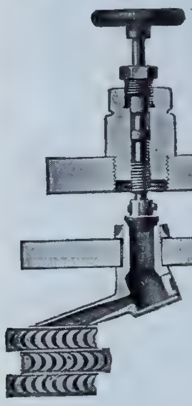
Write us for our illustrated catalogue of Ashton lines.

The advertiser would like to know where you saw his advertisement—tell him.

A Look into the Casing
of a
DE LAVAL
Class "C" Turbine



THE nozzles are individually formed to the correct shape by reaming and are so fastened to the wall of the wheel case that they are easily removable. The guide vanes are formed by drop forging, retaining the original glossy finish imparted by that process. They are held in steel retaining rings, which will effectually protect the surroundings in case of accidental overspeeding. All parts subject to wear are easily and quickly renewed and all moving and working parts may be removed without disconnecting the supply and exhaust piping. Steam at high pressure does not enter the wheel casing, but only the steam chest cored in one wall of the casing.



In addition to a powerful speed governor, there is an entirely independent emergency cut-off. All elements have been introduced which would contribute to produce a reliable, safe and efficient turbine for driving centrifugal pumps, and blowers, direct and alternating current generators, etc.

For further particulars send for our Catalog C-61.

DE LAVAL
STEAM TURBINE CO.

Trenton 71 **New Jersey**

Turbine Equipment Co., Ltd.

Canadian Pacific Bldg. **Toronto, Canada**

MESSRS. TAYLOR & YOUNG,
513 Pacific Bldg. - - - - Vancouver, B.C.

FAIRBANKS - MORSE BOILER FEED PUMPS

are chosen on their merits. They are *Small Pumps Built like Pumping Engines.* The highest standards in selection of material — construction — testing — are carefully maintained. Every piece is made to gauge and all parts are interchangeable. The valve areas are unusually large, the water cylinders are all brass lined, all pipe connections are flanged—the steam valve seats are hand scraped.

Fairbanks-Morse Pumps are made in a great diversity of types and sizes for every need. Our Engineers are at your disposal.

The CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

Montreal St. John Quebec Ottawa
Toronto Hamilton Ft. William Winnipeg
Regina Saskatoon Calgary Edmonton
Vancouver Victoria

Canada's Departmental House for Mechanical Goods

THE CANADIAN FAIRBANKS MORSE CO. CFM

POWER HOUSE EQUIPMENT

Fairbanks Coal Scales, Coal and Ash Conveyor Systems, Fairbanks Valves, P.&C. Valves, Pipe and Fittings, Packings, Steam Specialties of all kinds, Pipe, Tools and Thread-Cutting Machinery.

Producer Gas Plants.

Fairbanks - Morse Oil and Gas Engines, units up to 200 H.P. for belt drive or direct connection.

Fairbanks-Morse D.C. & A.C. Generators, Fairbanks-Morse Internal Starter Motors.

Traveling Cranes — hand or electric.

Trucks, hand, electric or gasoline.

Steam and Power-Driven Pumps — Transmission Appliances—Hangers, Pulleys, Belt, Skefko Ball Bearings, Yale & Towne Chain Hoists.

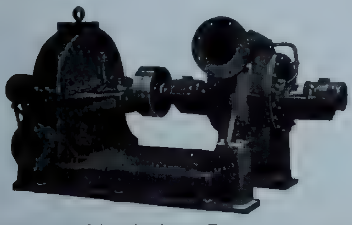
The CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

Montreal St. John Quebec Ottawa
Toronto Hamilton Ft. William Winnipeg
Regina Saskatoon Calgary Edmonton
Vancouver Victoria

Canada's Departmental House for Mechanical Goods

THE TERRY TURBINE

TERRY TURBO-ALTERNATOR
TERRY Turbo-Generator Sets are built in capacities from 1 to 500 K. W. (A. C. and D. C.). They are light, compact and free from vibration.



Terry Turbine-Driven Low-Head Pump
These sets, which furnish absolutely reliable service, are used with barometric condensers.

is the Ideal Drive For

PRIME MOVERS and AUXILIARIES

Horizontal, 5 to 1000 H.P. Vertical, 5 to 600 H.P.

HIGH, LOW or MIXED Pressure

The Terry Steam Turbine Co.

Represented in Canada by : T 195

FRASER & CHALMERS OF CANADA, LTD., 4 Phillips Place, Montreal.
THE HARE ENGINEERING CO., LTD., 78 Duchess Street, Toronto.
REFRIGERATION & ENGINEERING LTD., 700 Portage Avenue, Winnipeg.

MADE IN CANADA

WATER TURBINES
CENTRIFUGAL PUMPS
PULP AND PAPER MACHINERY

**Patronize Home Industry and Let
Us Quote on Your Requirements.**

Boving & Co. of Canada, Limited

94 Grafton Ave.,
Moose Jaw, Sask.

Head Office:
164 Bay Street, Toronto
Factory at Lindsay, Ont.

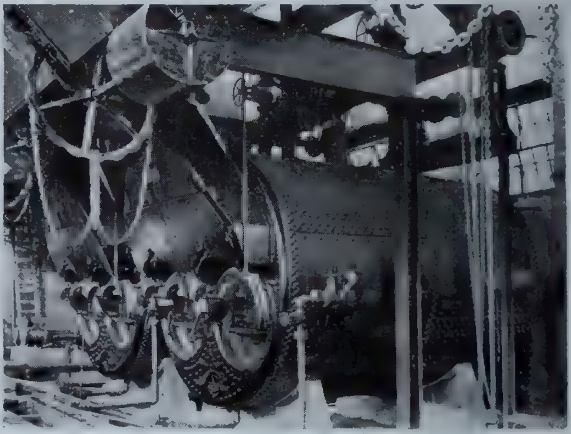
London Bldg.,
Vancouver, B.C.

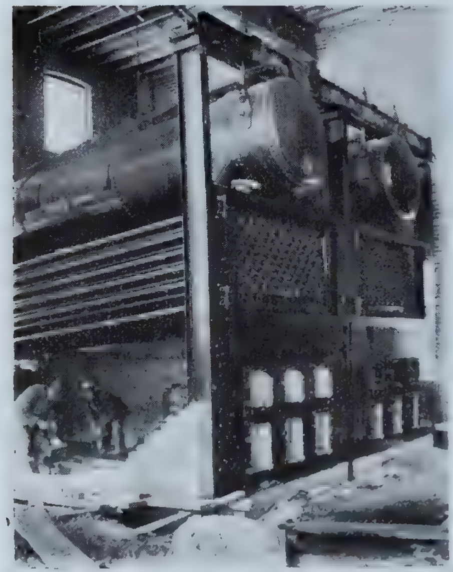
Mexico City, Wellington, Cairo, London, Eng., Tokyo, Johannesburg, Rio de Janeiro

Polson Marine and Land Boilers

have that reputation throughout Canada which can only be secured by many years of successful building.

Let us have your Plans and Specifications





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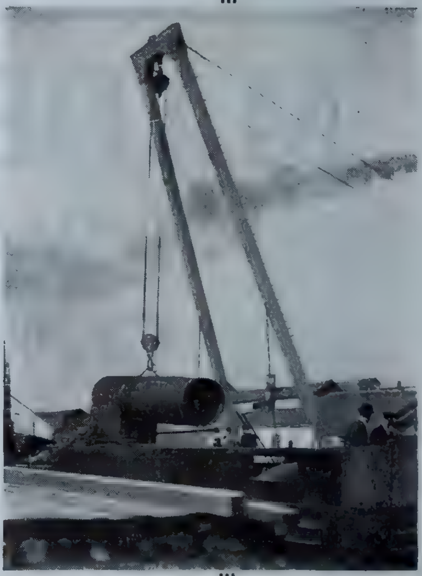

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High-Class Gas Engines and Gas Producer Plants

FOR ANTHRACITE COAL, COKE OR CHARCOAL

ENGINE.—Easy to start, easy to operate, silent running, absolutely rigid, perfect governing, excellent lubricating system, every part accessible, ample water-space, the best ignition, absolutely reliable.

GAS PLANT.—Our high-class gas plant makes it possible to generate power at about one-third of the price of steam power.

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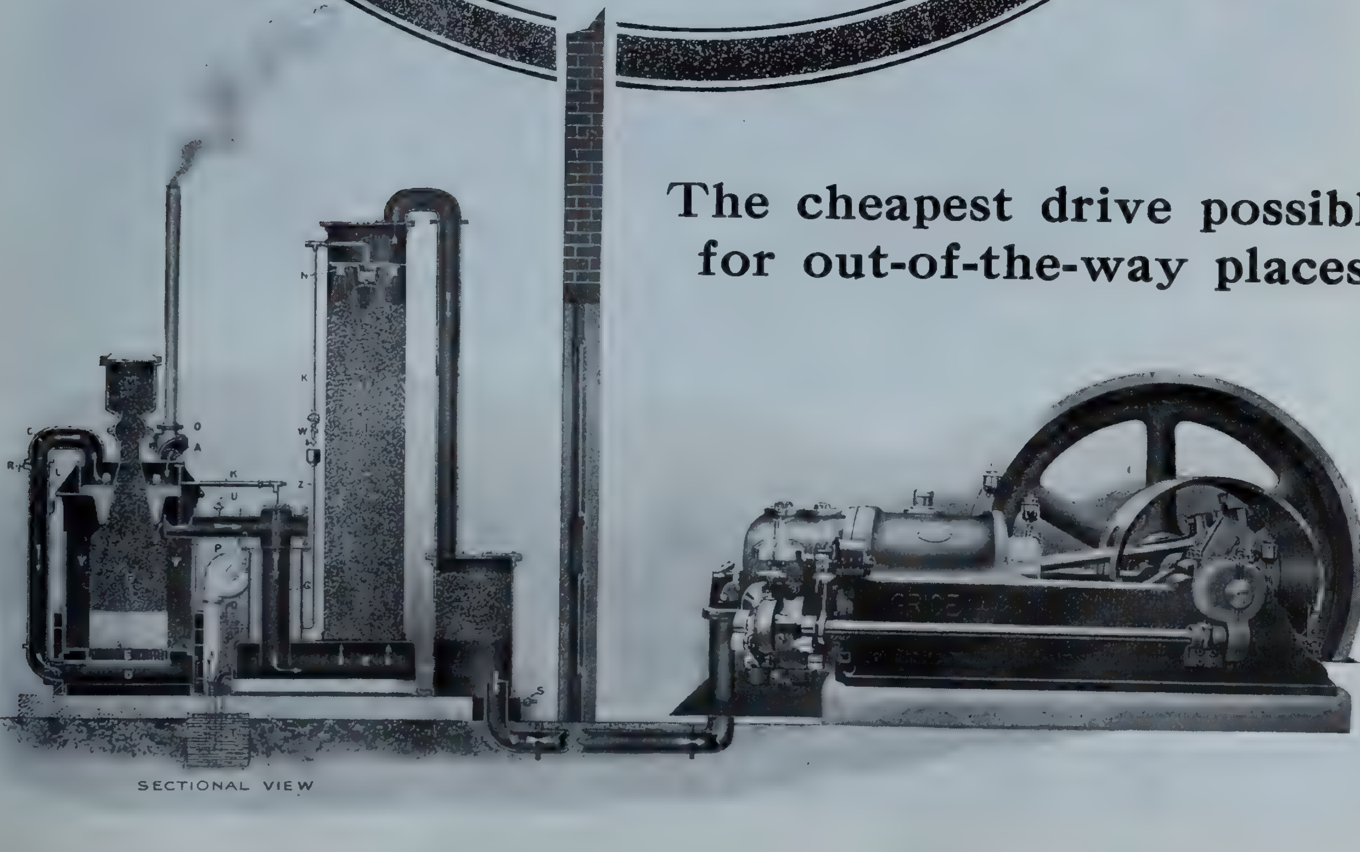

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SECTIONAL VIEW

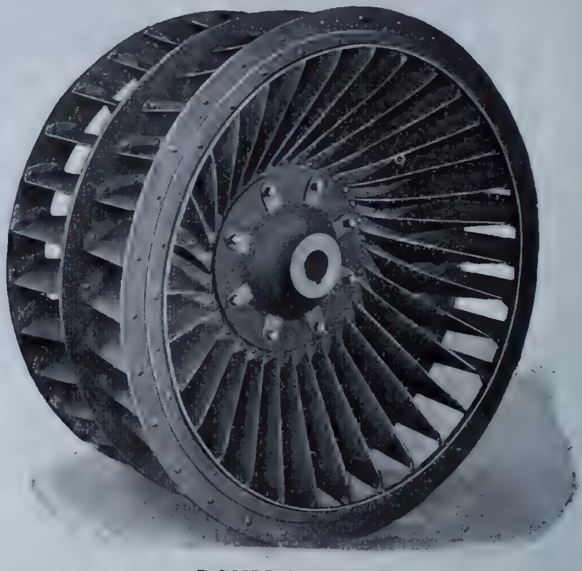
The "Keith" Fan Wheel

Stands first in efficiency largely because of the peculiar shape of the blades, etc. This wheel has proved of the highest efficiency in handling large volumes of air at uniform pressure over the entire width of the wheel.

The blades in their conical shape produce the most rigid fan wheel made.

These wheels are cut from the best material procurable, cut in shapes and pressed into their peculiar curves in our own shop at Galt.

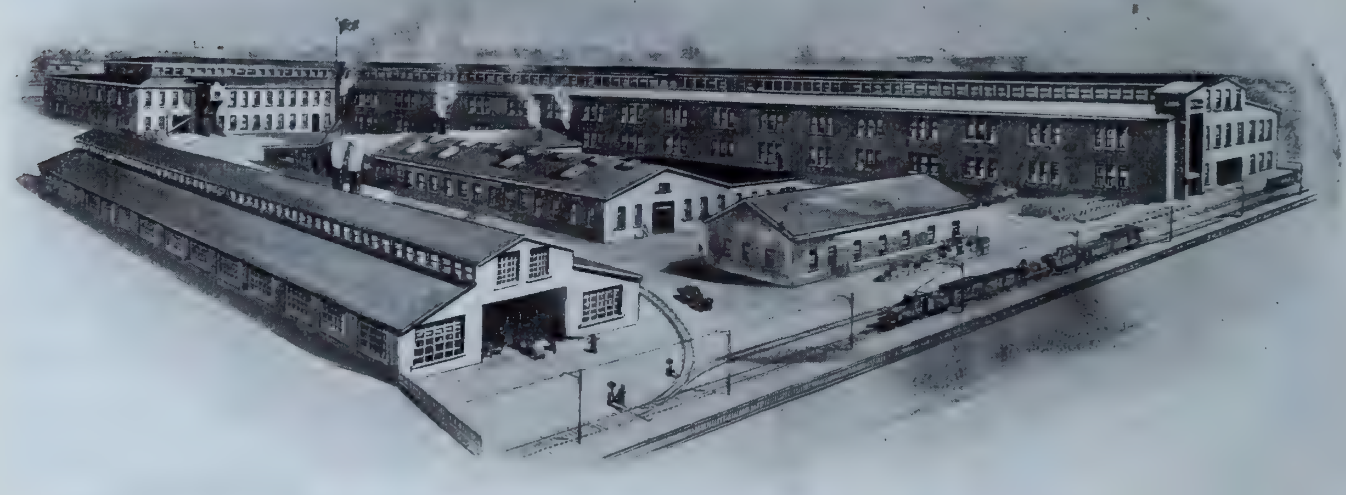
Though secondary to the efficient operation of a mechanical unit, the workmanship is given due consideration on all of our product and is of the best, particular attention being given to the finish and general appearance of all parts entering into the construction of our fans, etc.



DOUBLE WHEEL

Send for a copy of our Keith Fan Catalog. Just Out.

In compiling this catalog it is our desire to point out a few of the salient points wherein the KEITH FAN differs from other multiple blade wheels and to give you exact information and data concerning the performance of the Keith Fan together with dimensions of the various arrangements included in our standard designs. The **tables of capacities** given in the catalog are the result of exhaustive tests made of the fans under actual operating conditions and are dependable for the speeds and pressures shown.



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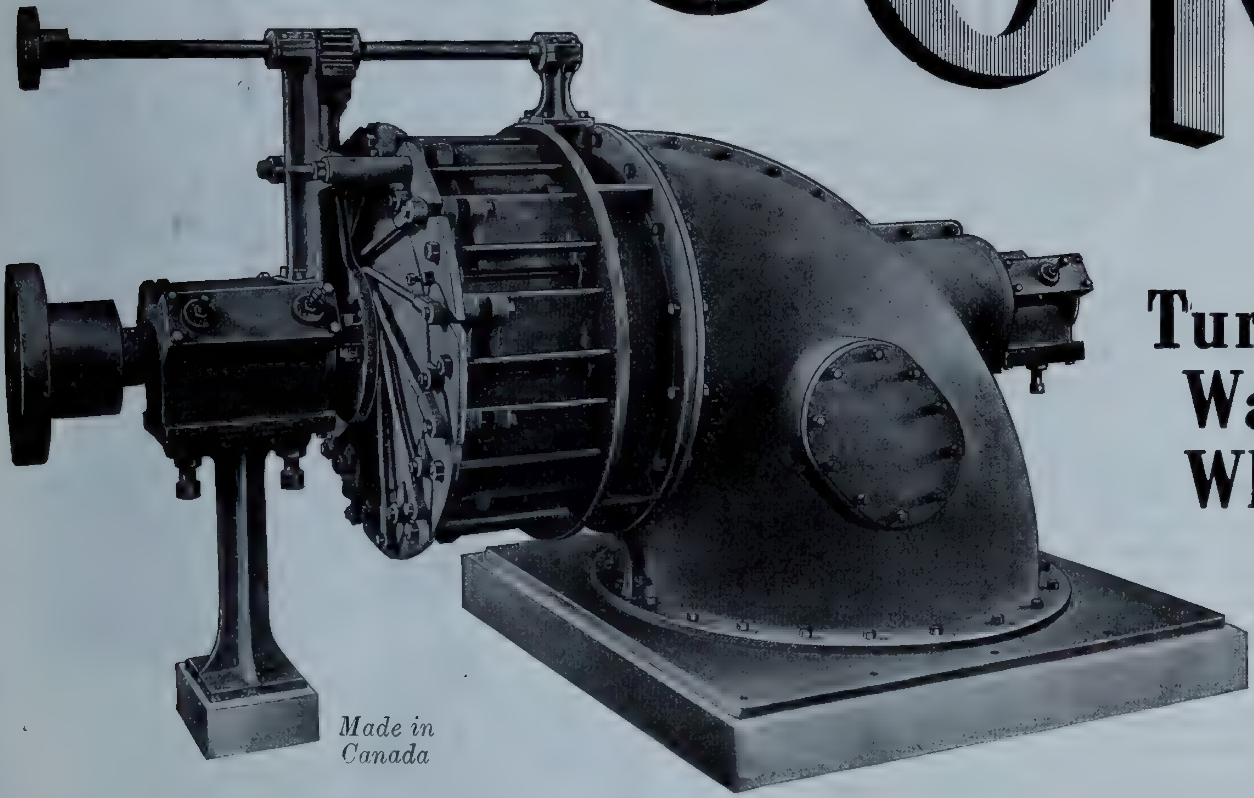

Made in Canada

Turbine Water Wheel

TESTS at Holyoke, Mass., which is the only recognized testing flume in America, has shown **Samson efficiencies better** than any other Canadian wheel has ever shown, and that the Samson competes successfully in respect of efficiency with all the foremost wheels built either in the United States or Europe. This result is an accurate indication of the work they will do in actual operation, and it follows from this that Samson Turbines will produce distinctively superior results under all working conditions.

The double wheel feature has, by long practice and careful experiment, shown its superiority over either wheel separately, especially in the strength and durability of the runner, and it's adapted to greatly increased capacity in connection with high efficiency.

The double diameter feature, the outward discharge element, and a number of other very important patented features which have been developed during our large experience in building and practice has established the high and deserving reputation of the "Samson."

Every Samson Turbine is of workmanship and construction that has been developed from hard study, and the knowledge gained during 20 years' experience.

By ordering "Samson" Turbines you will get wheels that are fully equal, if not superior to European makes, and the war will not affect the delivery.

Full particulars will be interesting. Write.

Wm. Hamilton Company, Limited
PETERBOROUGH, ONTARIO

CANADIAN

TURBINE WATER WHEEL

THE highest perfection in **Normal Speed Turbines** is found in this wheel.

Normal Speed and Normal Discharge are now known to be the only **genuine guarantee of high efficiency** and satisfactory working qualities.

Critical buyers—and also well-informed members of the Engineering profession—realize that turbines designed for **intermediate conditions of speed and capacity** have a great range of efficiency to meet the varying conditions which are bound to obtain in practice. Also that **the governing qualities of these turbines are vastly superior to those of wheels designed for critical speeds.**

Normal speed turbines will stand variations from 30 to 40% either way before their usefulness ceases.

Horizontal and Vertical Shaft Installation of every type supplied.

Single "Stepless" Vertical Shaft Turbines a specialty.

The Canadian Turbine Water Wheel is modern in every detail.

Its efficiency was never disputed; starting at 80% it has risen to 85%.

While our construction was at one time considered light, it is to-day the strongest. **All castings are of semi-steel and bronze**: all links, bolts and pins have been doubled in size and are of best quality open hearth steel.

Manufacturing **only Turbine Water Wheels** and the Normal Speed—Normal Discharge type on the above lines our claims to—**High Efficiency, Ideal Governing, Strength and Durability are genuine.**

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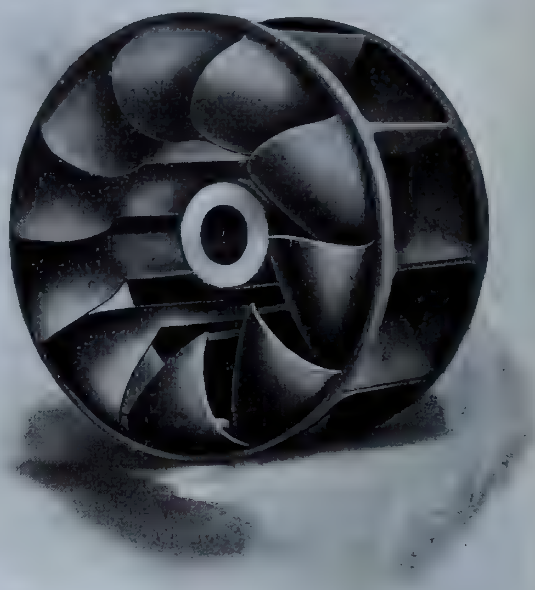
Designed and Manufactured by

CHAS. BARBER & SONS

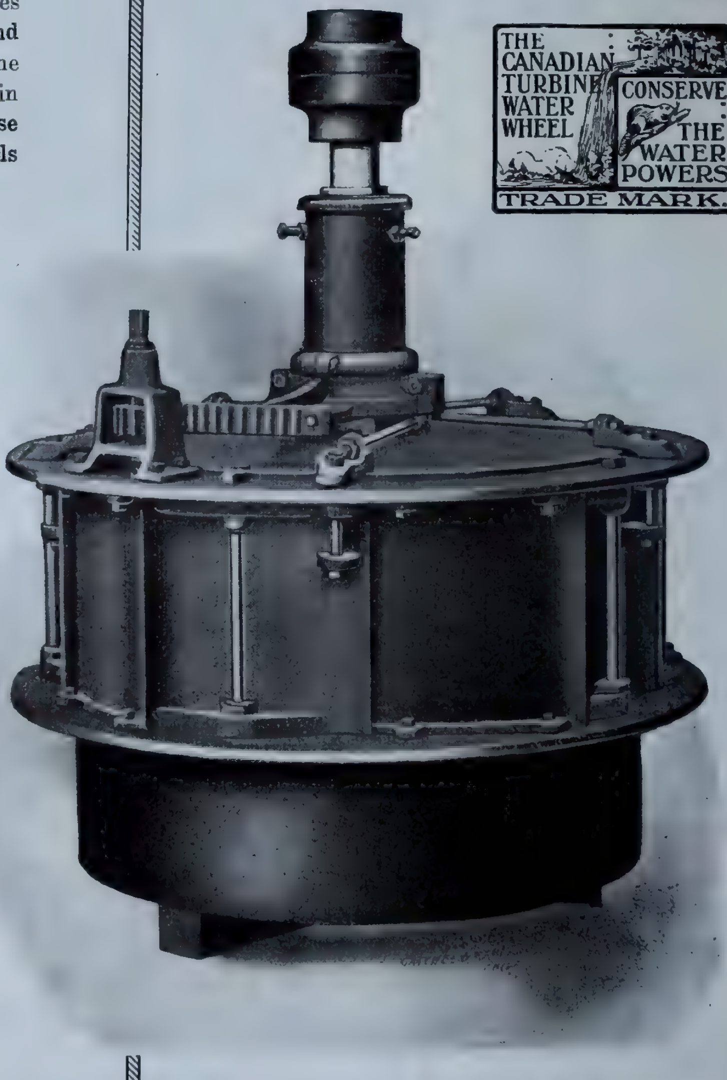
MEAFORD, ONTARIO, CANADA

Standard Runner



THE CANADIAN TURBINE WATER WHEEL CONSERVE THE WATER POWERS

TRADE MARK.



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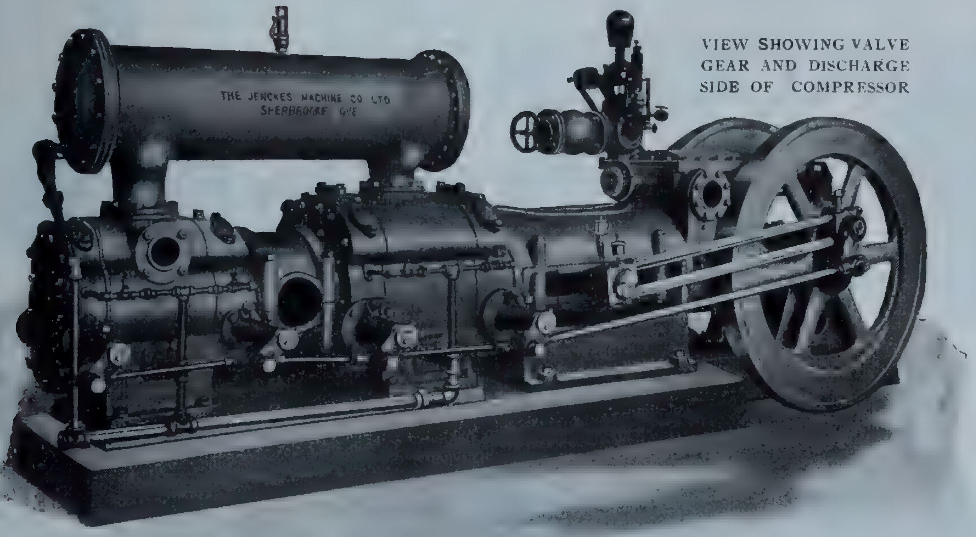
CLASS SS-2

With Simple Meyer Steam and Two-Stage Corliss Air Cylinders



VIEW SHOWING VALVE GEAR AND DISCHARGE SIDE OF COMPRESSOR

In this machine is combined the result of close scientific study and the benefit of large practical experience in the building, operating and observation of air compressing machinery, under widely varying conditions.

By using entirely new drawings and patterns we have been able to overcome many of the weaknesses and faults of other designs on the market.

This type is especially popular because of its compactness, maintenance, economy and high efficiency. It is particularly adapted for railway shops, general mining, contractors and industrial works, for operating mills, pneumatic drills, air lift systems, etc., and wherever a self-contained, convenient and dependable steam driven machine is required.

Every part is readily accessible. All materials are of the highest class and specially selected and treated for the service for which they are intended.

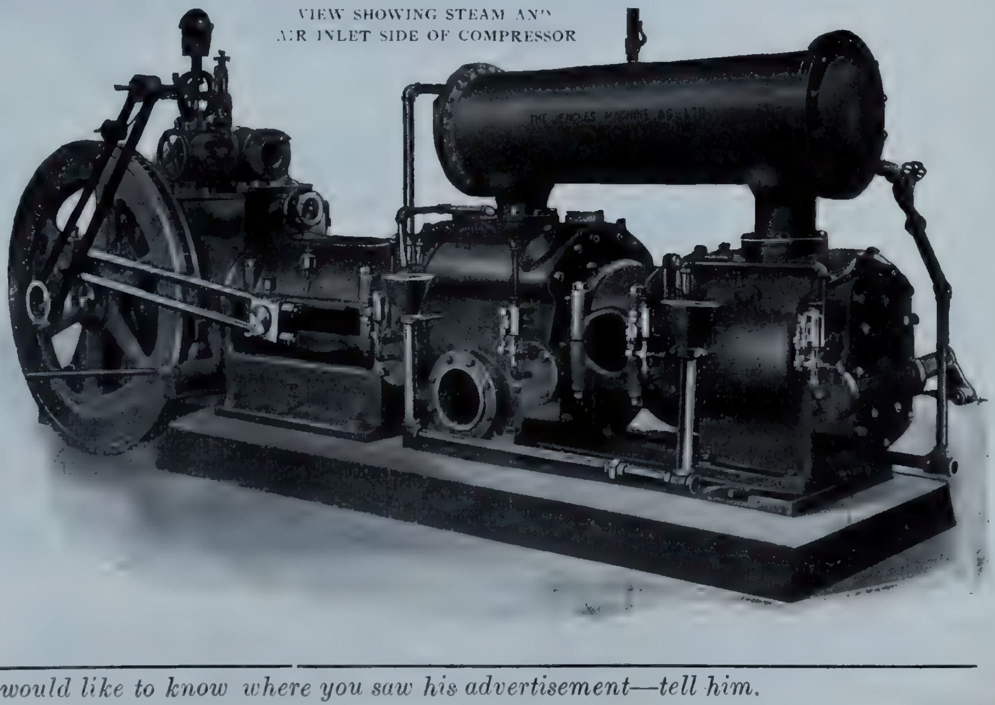
Write for catalog.—it gives full description.

We Manufacture

a full line of Air Compressing Machinery, including all the regular types, single and multistage, belt, steam or electric driven, up to and including Cross Compound Corliss steam driven machines, for large installations.

AIR REVEIVERS
HOISTING AND WINDING ENG.
BOILERS OF ALL KINDS
PULP MILL MACHINERY
TANK, PLATE AND STRUCTURAL WORK OF ALL KINDS

Requests for catalogs, estimates and information will be promptly honored.



VIEW SHOWING STEAM AND AIR INLET SIDE OF COMPRESSOR

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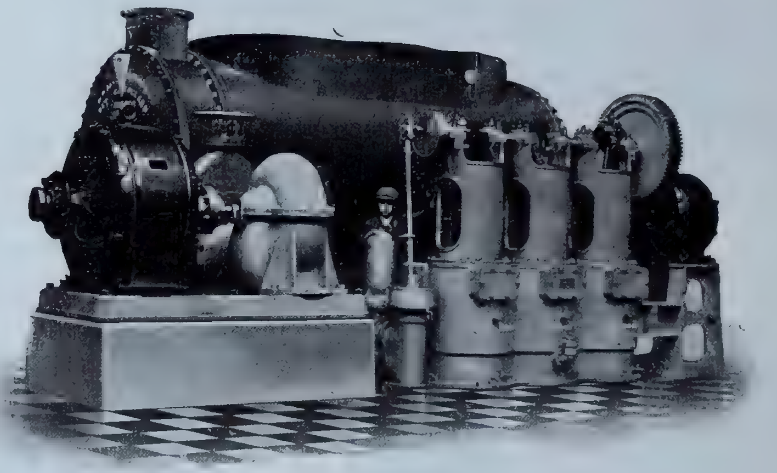

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Small quantity of circulating water.

Lower power required for driving pumps.

For prices and full particulars, apply to head office at

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BAWDEN PUMPS

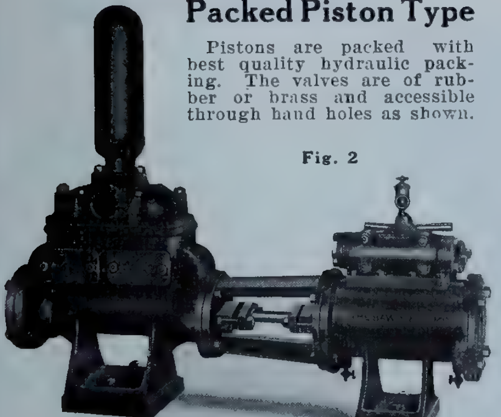
CANADIAN MADE

BAWDEN NEVER SHORT STROKE PUMPS

Packed Piston Type

Pistons are packed with best quality hydraulic packing. The valves are of rubber or brass and accessible through hand holes as shown.

Fig. 2



No Tappets.

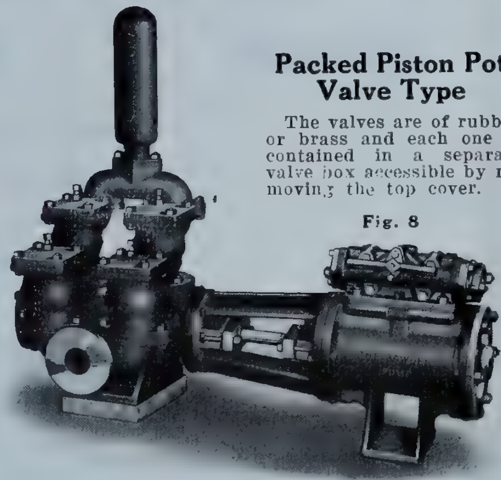
No Internal Valve Gear Levers or Springs

No Internal Tubes or Stuffing Glands

Packed Piston Pot Valve Type

The valves are of rubber or brass and each one is contained in a separate valve box accessible by removing the top cover.

Fig. 8



The Steam end has absolutely nothing to go wrong, it will make a full stroke under any and all conditions, run at any working speed without adjustment and has no dead centres, proved by the fact that it will run on water pressure as well as steam pressure.

OUR GUARANTEE

A. 25% saving in steam consumption over all standard duplex pumps.

B. To make a full stroke of the piston under all conditions.

C. Has no dead centres.

D. Run at any working speed without adjustment of any kind.

E. Not to knock or bang.

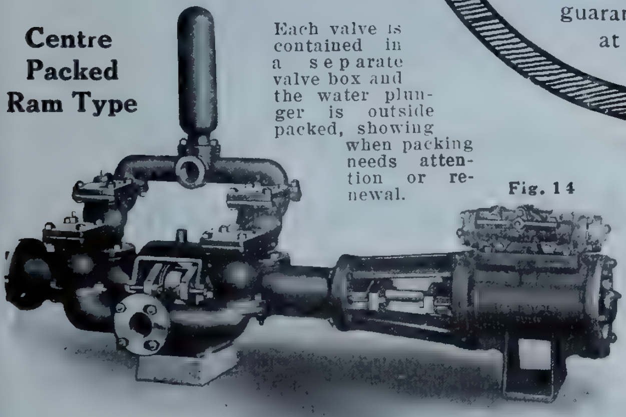
F. Pumps to be all we guarantee, or returned at our expense.

The water valves have the seats driven in on a special taper and held solid with brass stoppers through top cover, making it impossible for them to rattle or shake loose.

Centre Packed Ram Type

Each valve is contained in a separate valve box and the water plunger is outside packed, showing when packing needs attention or renewal.

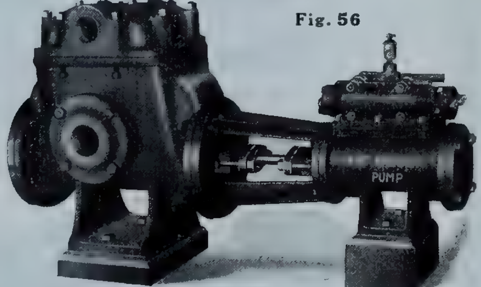
Fig. 14



Vacuum Pumps

These long full stroke pumps embody the best features for producing high vacuum. The pump valves have large areas and are all water sealed.

Fig. 56



PUMPS for all purposes

Bawden Basket Pump Strainers. Pipe Flanges. Hydraulic Presses.

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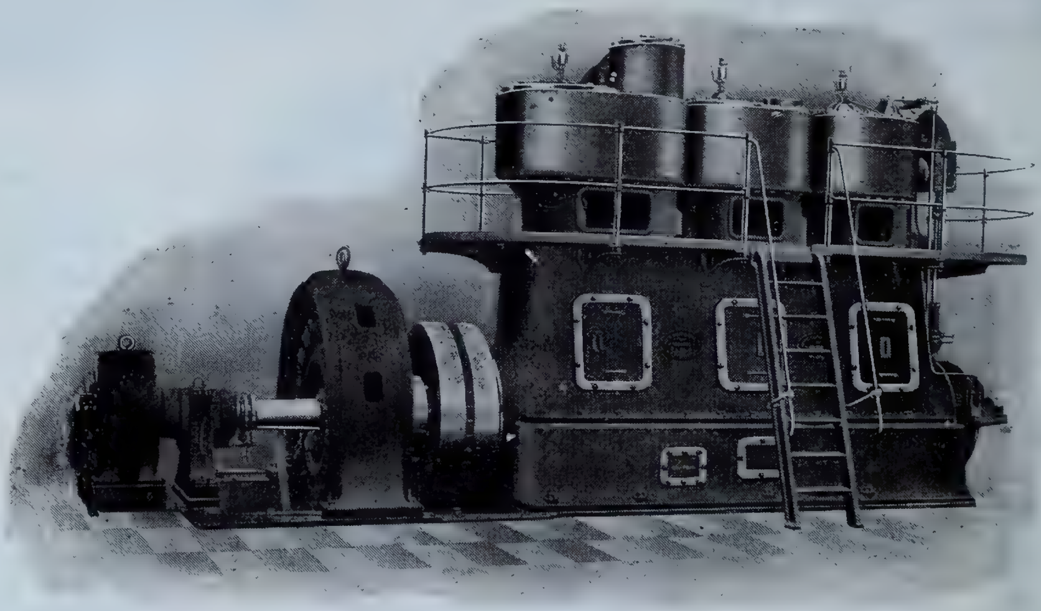
The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

Sole Agents for Canada:

**THE JOHN McDOUGALL
CALEDONIAN IRON WORKS CO., Limited**

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

Works: Seigneurs & Williams Streets, MONTREAL.

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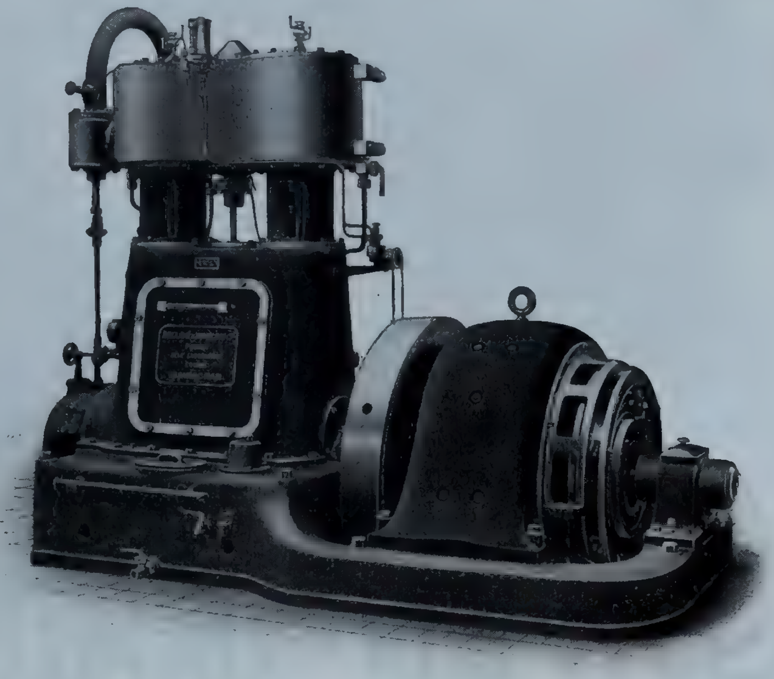
HIGH-SPEED ENGINES and COMPRESSORS

OVER 150 OF THESE SETS INSTALLED IN CANADA



250 B.H.P. Belliss & Morcom High-Speed Engine

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Complete
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Equipment
for Every
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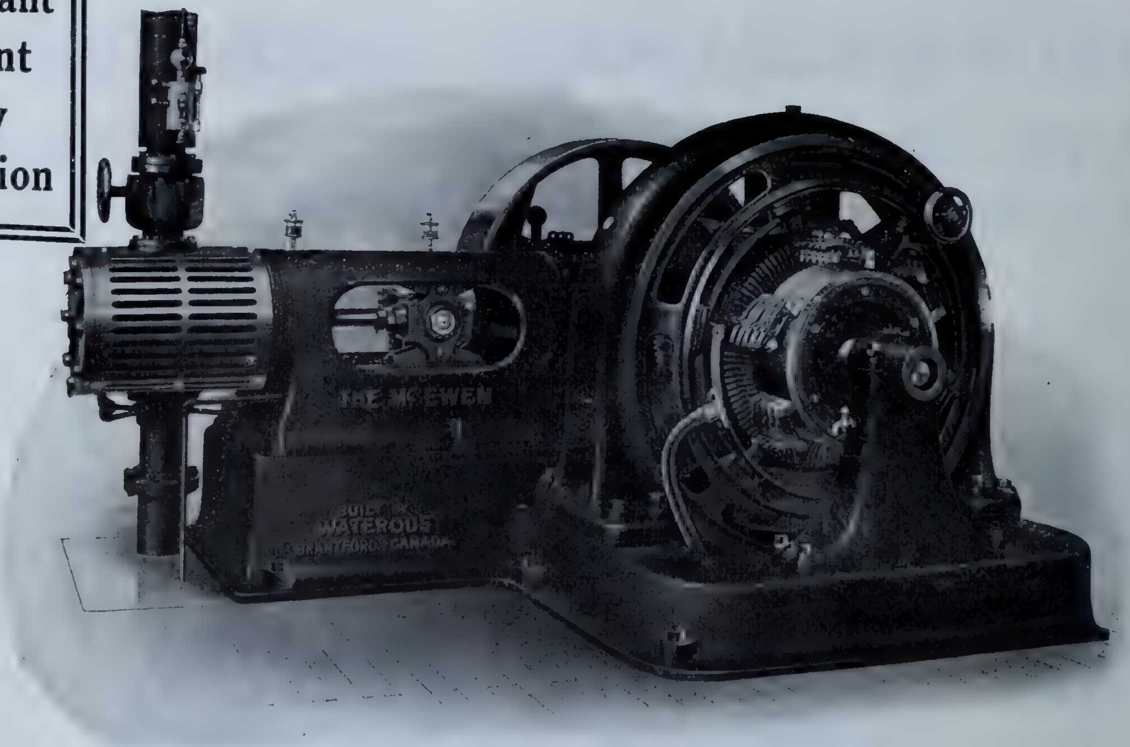

McEWEN HIGH-SPEED AUTOMATIC ENGINES

These dependable engines are built for continuous duty. They are your best insurance against costly repair bills and unexpected shut-downs.

They operate quietly and smoothly with an exceedingly close regulation under fluctuating loads. Sturdiness and their large reserve capacity enable them to respond instantly to heavy peak load demands.

Your careful investigation of their actual service performance record in all parts of the country is specially requested. Let us send you our list of McEwen users.

Built in simple and compound units up to 700 H.P. capacity. May we send you descriptive literature?

THE WATEROUS ENGINE WORKS CO., Ltd.
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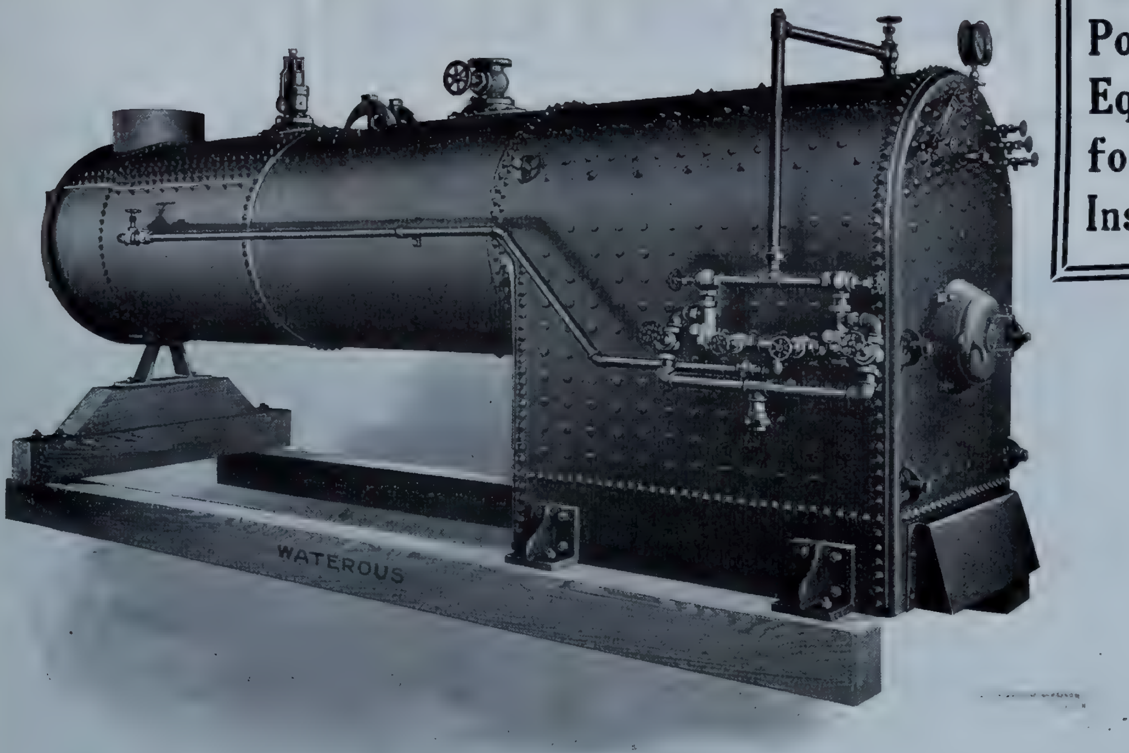
We Build Complete Power Plant Equipment for Every Installation



WATEROUS RETURN TUBULAR BOILERS

In both Stationary and Portable types, Waterous Return Tubular Boilers are specially suitable for every industrial use. They combine economy in fuel consumption, ease and convenience in operation, with absolute trustworthiness.

"Safety First" is not new as applied to these Boilers—it has been the idea behind every detail of their design and construction for fifty years and more. Exceptional care — exceeding the requirements of ordinary Provincial boiler building regulations—has been consistently exercised in the selection of materials and in every operation of their building.

Let the next boiler you buy be a "WATEROUS."

THE WATEROUS ENGINE WORKS CO., Ltd.

BRANTFORD, CANADA

GOLDIE & McCULLOCH CO.

SECTIONAL WATER-TUBE BOILERS

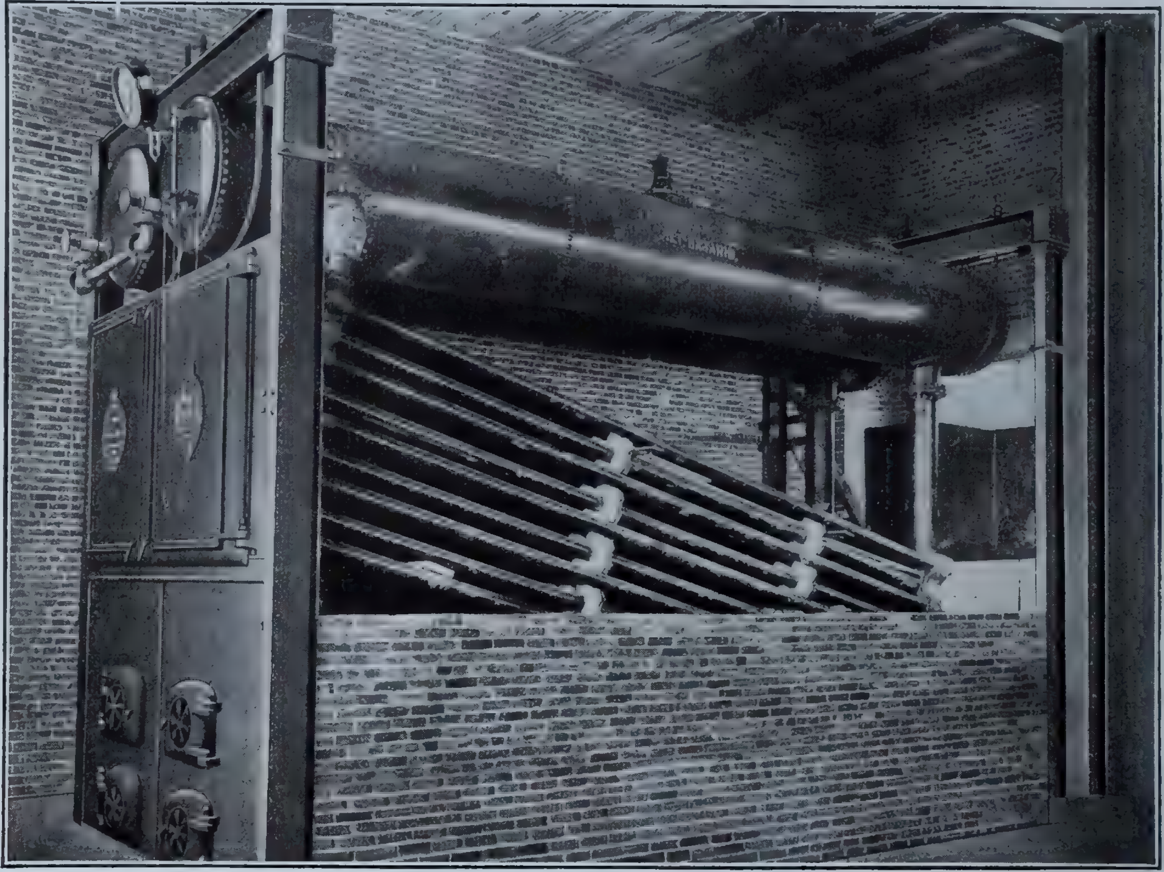


Illustration shows one of our Type A Double Drum, Sectional Water-Tube Boilers being installed at the plant of the Kelsey Wheel Co., Ltd., Windsor, Ont.

Have Positive and Rapid Circulation. Have Enlarged Area for Combustion. Have Steel Staggered Headers of Large Area. Have Increased Steaming Capacity. Have Straight 4-inch Tubes.

Our Bulletin No. 30 Illustrates and Describes the Different Types. ASK FOR A COPY.

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EQUIPMENT REVIEW

OCTOBER, 1914

THE CITY OF CALGARY, ALTA., AS SEEN FROM THE NORTH HILL.

Power Plant, Hudson's Bay Co. New Store, Calgary, Alta.

It is a notable fact that the most successful mercantile establishments are those which are operated by the highest type of mechanics and have installed the most up-to-date mechanical equipment. The outstanding achievements of this great Canadian institution, like those of the Canadian Pacific Railway, may be cited as bearing out the above statement.

THE energy of the Canadian West in demanding and sustaining the best is again exemplified by the new departmental store of the Hudson's Bay Co., at Calgary. This company, established in 1670 by Royal Charter, is one of the oldest commercial organizations in the world. It has been the great trading pioneer of the West and, with the building of this the first of a system of departmental stores of the most modern type, its prestige is still further established.

The city of Calgary is situated at the junction of the Bow and the Elbow rivers, 75 miles from the Rocky Mountains, and at an altitude of 3,500 feet above sea level. Its present population is about 80,000, its area is about forty square miles and its streets are well paved and lighted. The climate is severe and, in many other ways remarkable. The temperature in the long winter falls at times, to forty below zero for short periods, while cold weather may be expected as late as April. In the summer, the temperature remains between 70 and 90 degrees F., and the nights are always cool. In winter the daylight is short, dusk beginning shortly after 3 p.m., while, in summer, the daylight lasts till 9 o'clock.

A fairly good grade of bituminous coal is available at a rather low price, while abundant electric energy is available from a hydro-electric plant situated about 50 miles away and supplemented by a steam plant in the city. Natural gas is piped from one of the largest gas fields in the world and may be had in any quantity. Recent discoveries of large quantities of oil in the neighborhood will no doubt be an important factor in the fuel supply although the real value has not yet been thoroughly established.

The building of the Hudson's Bay Co., is 250 ft. by 130 ft., and is, at present, six stories high with provision for the addition of four more stories as the growth of the city warrants. The power plant is located in the western end of the basement and provides heat, light, refrigeration and power for elevators, pumping, ventilating and other services. The lighting load, on account of the short daylight in the winter time, is heavy. Nevertheless, the power generated is almost always a side product of the heating plant so that ,in making the installation, it was necessary to choose such units as would lend themselves most efficiently to this service.

The Boiler Room.

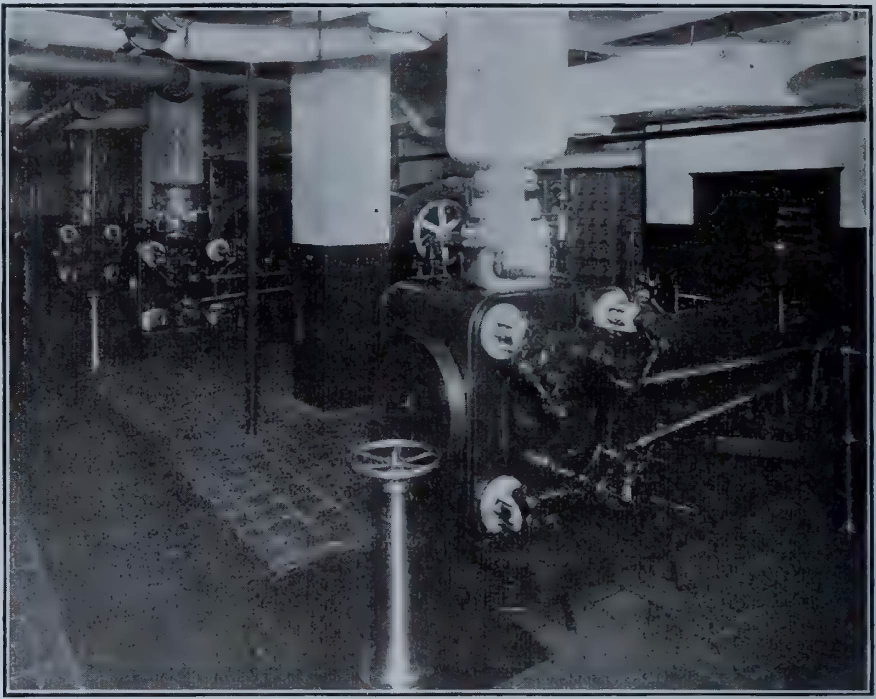
The boiler room is approximately 64 feet by 40 feet by 15 feet in height. The present boiler equipment consists of three water tube cross-drum boilers of 300 horse-power capacity each, built by Babcock & Wilcock, Ltd. Two of the boilers are set in battery and equipped with Babcock & Wilcox chain grate stokers. The third boiler faces the battery and provision is made for a fourth boiler. For the present, the third boiler is hand fired. The impracticability of securing a deeper excavation necessitated the use of the cross-drum type. The boilers are operated at 125 pounds pressure and are built to conform with the requirements of the Province of Alberta.

At the left of the single boiler is the coal vault, into which coal is delivered directly from chutes opening into the west lane. A short runway leads from the firing space to the lane lift, so that the ashes are easily removed from the boiler-room. South of the battery of boilers, next to the wall of the adjoining south pump room, is the blow-off tank, and on the other side of the wall are two steam-operated duplex drain pumps, $5\frac{1}{4}$ x $4\frac{3}{4}$ x 6 inches, which discharge the contents of this tank to the sewer.

On the north side of the boiler room, close to the wall of the engine room, is the combination muffler tank, oil separator and feed water heater. All condensed steam from the heating system and all clean drips are returned to this tank. Here are also two steam-driven boiler feed pumps, one a duplex outside-packed plunger type, 8 x 5 x 10 inches, and the other a compound duplex outside-packed plunger type, $5\frac{1}{4}$ and $7\frac{1}{2}$ x $4\frac{1}{2}$ x 10 inches. In the discharge line of the pumps is connected a Venturi water meter, the registering device and dials being located in the engine room, on the other side of the wall, so that accurate record of the water evaporated by the boilers may be kept. A steam injector is also installed and connected to the cold water mains to serve as an auxiliary source of supply, in case of accident to the boiler feed pumps. A vertical steam engine is used to operate the stokers.

The steam main header in the boiler room has connections taken from it through the wall to the engines. In addition, there is a separate steam main for auxiliary apparatus, which is connected into the header at each end. The header is provided with a dividing valve, and flexibility is secured by means of valves, so that a section of either header may be shut off for repair without shutting down the power plant. In the connection to each boiler is a triple duty Foster automatic non-return valve.

The smoke breeching is carried overhead and connects into a steel smokestack. This stack is self-supporting and is 151 feet in height.

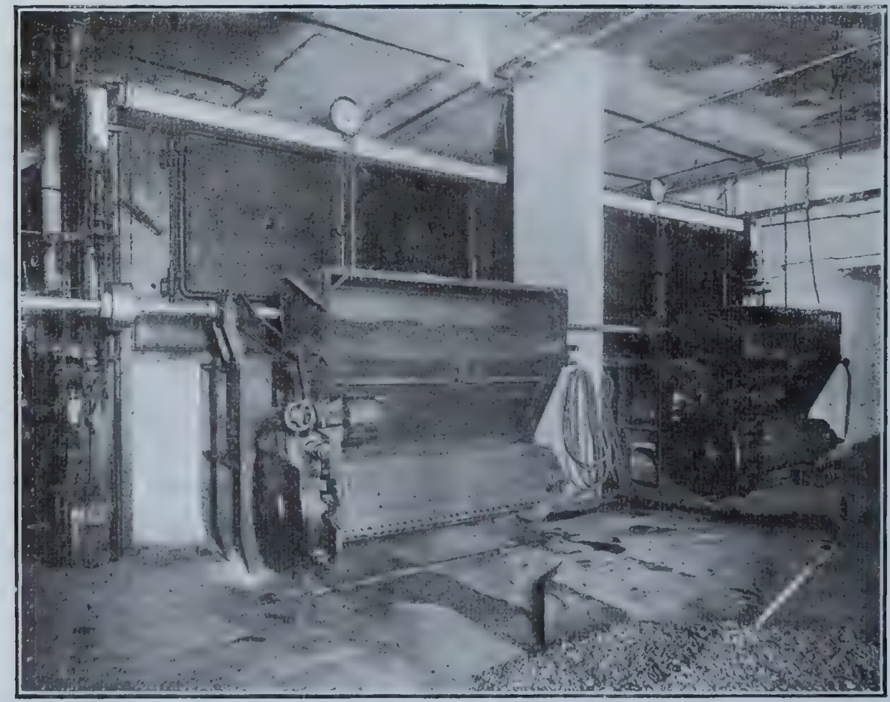


MODIFIED CORLISS ENGINES DRIVING GENERATORS.

The Engine Room.

The engine room occupies a space approximately 94 x 30 x 13 feet in height. The electric generating equipment consists at present of three 30--kilowatt, three-wire, direct-current generators directly connected to three simple four-valve steam engines of the modified Corliss type, rated at 480 horse-power but capable of developing 600 horse-power. In addition to this equipment, a similar unit of 150 kilowatts' capacity, for use during periods of little load, and a storage battery to take care of the peaks caused by elevator load, are contemplated.

The engines were built by the International Engineering Works, Ltd., of Amherst, N.S., with cylinders 24 x 24 inches, and operate at a speed of 150 revolutions per minute. The valves are of the Corliss type with Armstrong valve gear. In addition to the oil system for bearing surfaces, cross-head, etc., the engines are provided with Richardson force-feed lubricators which supplement those hand-operated, and Detroit lubricators for the cylinders. Above the throttle valve of each engine is mounted a vertical steam separator and in the steam connection to each engine is installed an electrically operated automatic safety stop valve of the Locke type, which automatically shuts off steam from the engine, if it exceed a predetermined speed.



BATTERY OF BABCOCK & WILCOX BOILERS WITH CHAIN GRATE STOKERS.

Generators.

The generators are of the three-wire type, with separate balance coils, which are installed in the rear of the switchboard and are equipped with inter-poles for obviating sparking at the brushes. The generators produce direct current at 230 volts for power and 115 volts for lighting.

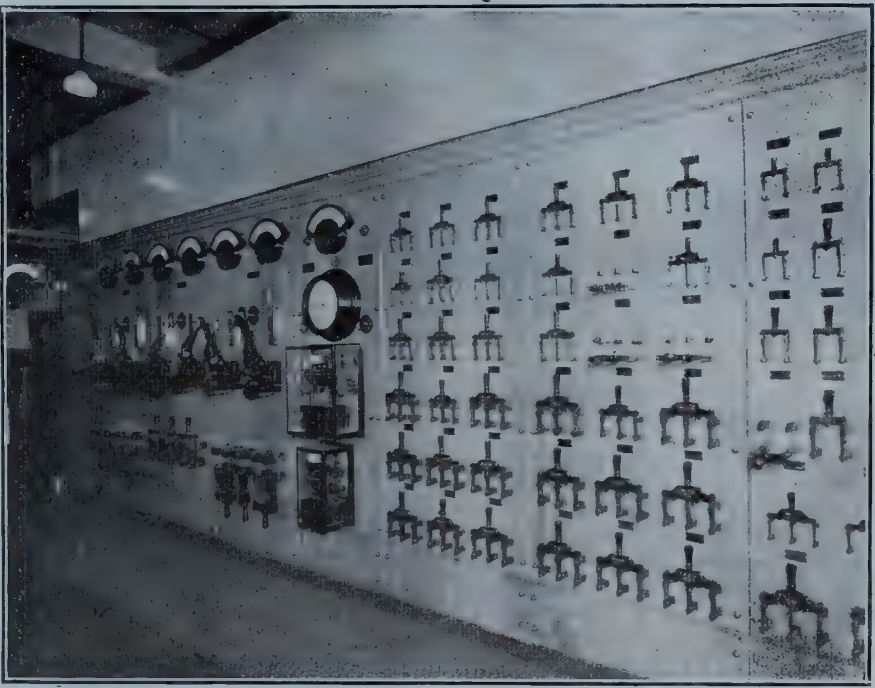
The switchboard shown in illustration is built of blue Vermont marble. It stands 7 feet from the partition behind it and is provided with an ornamental copper grille door set in a marble frame at the left end. There are nine panels, each provided with a marble sub-base, and the whole is surmounted by a marble cornice. The overall length is 27 feet and the height is 8 feet 4 inches. Each generator panel is equipped with two ammeters, a double-pole interlocking circuit-breaker, two double-pole and a single-pole fused switches, a field rheostat and a volmeter receptacle. On the totalizing panel are mounted an ammeter for registering the total output of the generators and equipped with shunts so that it may be used to calibrate the wattmeters; two Thompson astatic type integrating wattmeters, one to record the output for lighting service and the other the output for power service, ground detector lamps, a voltmeter switch, an ammeter switch and a clock connected to the store clock system described later.

The feeder panels are equipped with triple-pole switches for lighting and double-pole switches for power feeders. All fuses are mounted on slate slabs at the rear of the board and every switch and every fuse slab is provided with a copper name plate to identify it. At the left end of the board is a bracket carrying two indicating voltmeters—one reading 0-300 volts, the other 300-0-300 volts. The arrangement of voltmeter plugs and switch is such that the bus-bar voltage and the voltage of the incoming machine may be read simultaneously when paralleling generators. The generators and switchboard were built by the Canadian Westinghouse Co., Hamilton, Ont. The power for fire alarms, clocks, bells, etc., is obtained from two ½ horse-power Holtzer-Cabot motor-generator sets provided with a separate small switchboard.

At the west end of the engine room are located the ammonia compressor and condenser of the refrigerating plant. There are two pump rooms, the south pump room being at the same level as the boiler room and immediately south of it. This room contains the suction tank and house pumps and well pumps of the water supply system, the drain pumps, the exchanger and vacuum pumps of the heating system, the hot water heater and tank and the sump pit with its pumps and the deep well.

The north pump room connects with this, but is at the level of the general basement; that is, 2 feet 6 inches higher than the boiler room and forms a wing of the engine room. In the north pump room are located the brine cooler and tank, brine pumps, drinking water cooler and pumps and vacuum cleaning machine. The boiler room and south pump room are paved with Master Builders' cement. The engine room and north pump room are paved with red Welsh tile 12 inches square. All foundations which extend above the floor are finished with white enamelled brick, bull-nosed at the corners and surmounted by bluestone caps. The result is a clean, well-kept power plant.

All of the steam pumps were built by the Smart-Turner Machine Co., of Hamilton, Ont., while the electric pumps were built by the Morris Machine Works. All motors used in the store, excepting those for the elevator machines, were built by the Canadian General Electric Company.



VIEW OF MAIN SWITCHBOARD.

Heating and Ventilating Systems.

The heating system is divided into two parts. The main floor and the basement are heated by the indirect method—that is, by heated air which is blown into the spaces by means of large fans or blowers—while the upper floors are heated directly by means of steam pipe coils or radiators.

In the basement there are three fan rooms. One of these is located at the east end of the building and the other two along the north wall, each being placed under one of the main vestibules. The rooms are similarly equipped, with a few slight exceptions. Fresh air is drawn through gratings in the sidewalk, and, after passing through a wire mesh screen to exclude leaves, etc., enters a galvanized sheet-iron duct and is conducted through a tempering coil consisting of sections of Vento heating stacks. The first sections of these stacks are supplied with live steam so as to prevent freezing during extremely cold weather at night, when there is little exhaust steam.

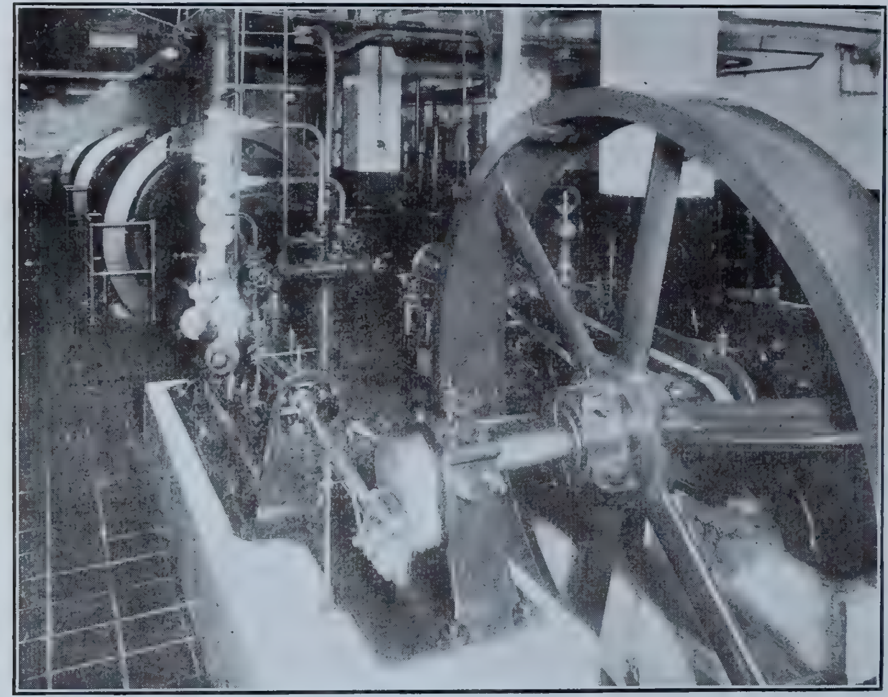
The ducts leading to the first floor terminate in enameled cast-iron registers placed at intervals along the walls at a height of approximately 7 feet above the floor, and registers in the display fixtures near the entrances The ducts for the basement are run along the ceiling, with branches terminating in wire mesh register faces. All ducts are provided with dampers for regulating the flow of air

In each ventilating room is also placed a smaller fan. These fans draw air in from the general basement or shipping room over heaters of Vento stacks, and discharge the heated air into the vestibules through the register faces under the vestibule show windows. In this way cold draughts in the store are prevented with the constant entrance and exit of customers. The store temperature is maintained at 70 deg. F.

These fans are of the multi-vane type and are direct-connected to electric motors, securing variable speed by both armature and field control. All fans used in the building, as well as the air washers, were built by Sheldons, Ltd., Galt, Ont.

There are three thermostats located

on the main floor and three in the main ducts, which control the temperature in the main ducts and the valves to the reheaters; also thermostats in the fresh air intakes, which control the supply valves of the tempering coils and prevent their freezing. The air to the thermostatic valves is furnished by two small compressors with a storage tank. The Johnson service system is used. In addition to the above, the Tycos temperature indicators are installed throughout the building, three being placed on each floor and one out of doors. These are electric resistances, and register on a signal board in the chief engineer's office. The signal board consists of a thermometer scale with a small lamp opposite every 5 deg., i.e., 50 deg., 55 deg., 60 deg., etc., with a small switch corresponding to each station. On closing the switch the lamp is lighted opposite the figure which indicates the temperature at the locality in question. The chief engineer is thus enabled to determine, without leaving the engine room, if all parts of the building are properly heated.

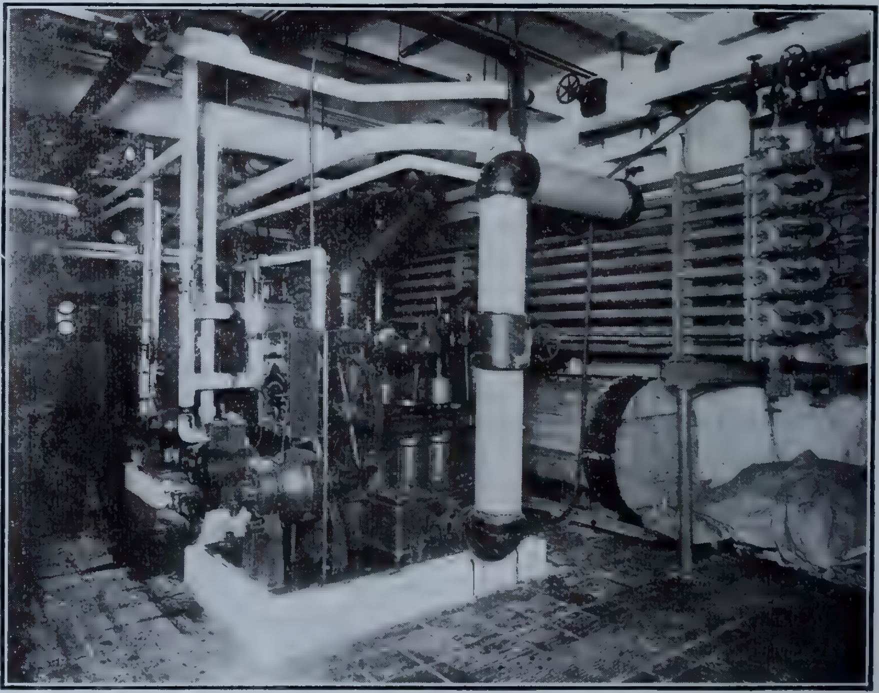

LINDE-CANADIAN AMMONIA COMPRESSOR.

The upper floors are heated by means of double return bend coils of wrought-iron pipe mounted on floor stands and placed directly under the windows. Each coil is provided with a single supply and a single return valve. These coils form an efficient, neat and compact radiating surface and are easily cleaned of dust. In the restaurant and smoking room the coils are enclosed in boxes with grilles. In small rooms and on the stairways cast-iron radiators are used.

The total heating surface in the building is equivalent to more than 50,000 square feet of direct radiating surface. The heating system is a double pipe vacuum return system with Monash-Younker "Radifier" valves on the return connections. The heating mains are run in the basement and are supplied with exhaust steam, with a supplementary live steam connection through a reducing valve. Provision is made in the atmospheric exhaust riser just below the back-pressure valve near the roof for a connection for an overhead main for the future stories. The return lines are connected to the exchanger in the south pump room, from which the returns are drawn by two 8 x 12 x 12-inch vacuum pumps and discharged to an air separating tank hung from the ceiling, from which they are delivered by gravity to the muffler tank.

In addition to blowing fresh air into the main floor, circulation is maintained and the vitiated air removed through a large register near the ceiling at the southwest corner of the store, which connects with a vertical flue. The air is withdrawn through this flue by means of a multi-vane fan of 37,350 cubic feet per minute capacity, located in a pent house on the roof and discharging directly upward through the roof. The air is exhausted from the shipping room in the basement and discharged into the engine room by means of two 54-inch cone fans mounted in the partition. The air from the engine room is discharged into the boiler room by means of a 48-inch propeller fan in the wall between these rooms. These fans are provided with doors which close automatically in case of fire and prevent its spread to the engine room. From the boiler room a large duct is connected to the space surrounding the smokestack. The space is tightly enclosed and is connected at the top to the suction of a fan similar to the one just described above and placed immediately adjacent to it. This space also receives air from the engineers' toilet room as well as that from the pump rooms by means of a duct rung from the ceiling of the south pump room

The employees' toilet rooms on third and fourth floors, and the separate toilets on the south side of the building are ventilated in the same way by fans and ducts leading to the roof, while


TRIPLEX PUMP AND AMMONIA CONDENSER.

restaurant and cafeteria, kitchen and bake-rooms are ventilated by two 48-inch and one 18-inch fan and ducts discharging through the west wall. All fans are fitted with variable speed controllers of Cutler-Hammer make.

Illumination.

The illumination of a departmental store, always a vital feature, is, in this case especially attractive. The main floor is lighted by means of intensified arcs with triple carbons, made by the General Electric Co. These lamps are mounted in handsome spun brass casings of the Amboy Works, Perth, Amboy, N. J. The inner and outer globes are of Alba glass, pear-shaped and are hung by ornamental brass chains. The light is a near approach to daylight and the whole creates a very pleasing decorative effect. In the selling departments of the upper floors the semi-indirect system has been adopted. Each 14-inch moonstone bowl is served by a 250-watt tungsten lamp giving 1.25 watts per sq. ft. of floor space. In other departments, the fixtures used are suited to the decorative effects and the purpose of the lighting, with the idea in each case of securing the best effects.

Electric Wiring.

Some idea of the extent of the wiring system can be gained from the fact that the number of outlets for all purposes approximates 4,400. To connect these, more than 140,000 feet of iron pipe conduits were installed containing approximately 400,000 feet of rubber-covered wire.

From the switches on the feeder panels of the switchboard in the engine room, the feeders are taken up to a junction box directly over the switchboard and extend its whole length. This allows changes in feeder connections. to be made easily and without confusion. From this junction box. two-wire feeders are carried to the 42 electric motors located all over the building besides those in the workrooms. The lighting of each floor is controlled from four black slate panels on the south side of the floor. Each two-wire branch circuit is controlled by a push-button switch so that it is unnecessary to open the door which covers bus-bars, fuses, etc.

These panels are fitted with two sets of bus-bars one for night lighting when cleaning is being done, and the other for the day service, both sets being in use during business hours. Roof standards, pent houses, etc., are lighted from a panel in one of the pent houses. Panels for controlling elevator, hall, stairway, shipping room, engine room, lights, etc., are located in the basement while those for the show windows are operated from five panels on the main floor.

For supplying power for sewing machines, electric irons, and other purposes in the work rooms, a separate set of feeders is installed in each end of the building. The current for power is supplied at 230 volts and that for light and irons at 115 volts. The wire used throughout is known as "Imperial Highgrade," manufactured in Montreal by the Imperial Wire & Cable Co.

Telephones, Clocks, Etc.

A complete telephone installation connected to the service of the Alberta Government system, has been provided. A large operating switchboard is installed on the second floor and stations are provided for all departments as well as customers. The distribution for each floor is served from two junction boxes one at each end of the building. Each elevator car is connected by telephone with the chief engineer's office as a safeguard against accidents. All clocks, two on each floor, one outside and one on the switchboard are operated by electricity from a master clock of the mercurial compensated pendulum type.

The store is supplied with water from two sources, the city mains and a deep well in the south pump room. The former is used for drinking, wash basins, boiler feed, etc., while the latter is used for, flushing toilets, fire lines, condensing ammonia, etc. Besides the house pumps, there is a 500 gallon underwriters' steam-driven duplex pump, for fire purposes. The water from the deep well is raised in the building by one steam-driven 6 and 9-inch by 7 x 10-inch compound simplex outside packed plunger pump, and one motor driven single acting triplex 100-gallon pump, an air lift being used to bring it from the well.

Water for the sprinkler system is supplied from two sources namely, a 6-inch connection to the city service and from three tanks on the roof of 7,500 gallons capacity, each of which are kept under a pressure of 75 pounds by compressed air supplied by two steam driven compressors in the basement. These latter also supply the dry pipe system and power for operating elevator doors. The vacuum cleaning system consists of a four-sweeper machine of the Rotrex type belted to a motor and discharging dirt from all parts of the plant into the sewer.

Refrigeration.

The refrigeration plant is used to cool the water for drinking purposes and to cool the refrigerators used in connection with the kitchen and the grocery department. The plant was originally designed on the absorption system and, as exhaust steam would be required for this type, steam operated pumps were installed. It was later decided however, to omit a large fur storage vault which required the absorption system and adopt the compression type of plant.

The plant is of 20 tons refrigerating capacity. The ammonia compressor is steam-driven, the steam end being 10 x 28 inches and the ammonia end 9 x 15 inches. The condenser is of the double-pipe type. A shell type of brine cooler is used. All of this equipment was built by the Linde Canadian Refrigeration Co., Ltd., of Montreal.

The calcium chloride brine is pumped by means of two pumps, one a 7½ x 4½ x 10-inch duplex steam pump and the other a triplex motor-driven pump of 75 gallons per minute capacity, through the cooler and thence up through a rising line, through the coils in the refrigerators on the third and sixth floors. The two groups of coils are in series, but the coils of each group are in multiple. Either group may be by-passed and each coil is valved at both ends with valves of the lock-shield type. The brine returns by gravity to the brine tank, first passing through the coil in the drinking water cooler.

The water for the drinking water system is taken from the city supply and, after passing through a Buhring filter, enters the cooling tank. The latter is of 300 gallons capacity and the water is cooled to a temperature of 39 deg. F. From this tank the water is pumped through a rising line, to which are connected the fountains. There are two pumps, one a 5¼ x 3½ x 5-inch duplex steam-driven, and the other a motor driven triplex pump of 25 gallons per minute capacity.

All brine piping and ice water piping is covered with cork insulation and canvased. To avoid confusion in locating connections to the various systems of piping. the following color scheme has been adopted for the covering in the basement:

High pressure steam piping.	White
Exhaust steam piping.......	Yellow
Drip piping	Yellow
Cold water piping..........	Blue with white bands
Hot water piping...........	White with red bands
Heating mains	White with yellow bands
Vacuum return mains.....	White with green bands
Brine piping................	Green

The work of construction and installation in all departments was done by carefully supervised contracts. The general contractors for the complete electrical and mechanical equipment excluding elevators were L. K. Comstock & Co., of New York and Montreal, while Carter-Halls-Aldinger, of Winnipeg, were the general contractors for the structure.

We are indebted to the Hudson's Bay Co. and the Isolated Plant for the photographs and editorial feature details, respectively, of this article.

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MEETING THE SITUATION.

TO at one and the same time increase the factory quality and quantity output so as to meet not only competition, but to offset the efficiency practised in purchasing one's product as exemplified in the methods to be noted of doing so, is admittedly shrewd business generalship. That only a competitors' methods, plant and equipment are considered and given prominence in shaping business conduct seems to be an all-too-common practice. We seem to fail to realize that much can be learned from those with whom we trade.

Is it not the case that too many of us adopt the "growler" attitude because a competitor or even a customer through organized and efficient methods gets ahead of us. We fail to note, yes, have not at this late day realized that the continuous and enlarging success of our enterprise is dependent to a great extent on what others are consciously or unconsciously laying to our hand and teaching us. We seem to forget that what another can do, so can we likewise if we set ourselves.

The whole fabric of business intercourse, producing and purchasing, hinges on this system of appropriating to ourselves what is worth while, and in the suppression of our discontent and harsh criticism of the progressive methods of others.

◆

ORGANIZATION EFFICIENCY TESTING TIME.

A PERIOD of business depression such as the industrial world is now experiencing may not be altogether so unsalutary both in its present and after effects as would seem at first sight to be unmistakably probable. We refer to the opportunity it affords of testing the individual and collective efficiency of an organization. In boom times and even in normal times of business, although perhaps more noticeable in the former, less effort, comparatively speaking, is needed, and certainly less display of resourcefulness is required than in circumstances like the present. In the matter of results, it matters not the nature of the enterprise, neither does it concern only those who manage or direct, for in the ultimate analysis each individual unit must bear a part.

Ebbing business returns in the experience of an organization may or may not be due to a widespread general depression, nevertheless, be it from such a cause or simply an isolated happening, there is an unmistakable call to search out and get rid of the deadwood.

Reference to this being a testing time for our captains of industry in the matter of initiative in securing business in new directions has already been made in these columns. Slowing-up of the wheels of industry permits of opportunity by a management to look more closely at and get into more intimate touch with the individual worker. It operates to bring out what lies below the surface, if such there be, and enables a line of action to be framed and a disposition of forces made that will not only meet existing conditions successfully, but will lead to greater and more extended future achievement.

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Steam and Its Generation

GAS FIRING FOR BOILERS.—I.*

THE continuous increase in the number of gas-fired boilers makes it desirable to draw the attention of the gas consumer more closely than has hitherto been done to the working efficiency of such boilers and the influence which the devices used for supplying the gas to the boiler has upon the effective utilization of the gas. It is frequently averred that the devices at present in use enable 4 lbs. and upwards of steam to be generated per sq. ft. of heating surface, and that this is perfectly staisfactory. This satisfaction, however, is ill-founded, so long as the output alone and not the efficiency of the boiler is high. The gases used for firing boilers in collieries and the iron industry are chiefly coke-oven gas and the blast-furnace gas; and these two alone will now be considered in detail, with brief mention of the producer gas, Mond gas, natural gas and coal gas occasionally employed in steam-raising.

It is not intended to discuss whether the gas can be more advantageously utilized in large gas engines or for steam raising, although it may be mentioned that the hopes of the makers of large gas engines—who, some few years back prophesied the disappearance of the gas-fired boiler and the exclusive triumph of the large gas-engine—have not been fulfilled. On the contrary, gas-fired boilers have become more popular, especially for colliery work, more particularly because the question of whether the large gas engine or the steam engine fed from gas-fired boilers is the more economical has not yet been settled.

The Bone boiler, heated by flameless surface combustion, will be merely touched upon, as boilers of this kind are still few in number; and there is no doubt that a great many tons of water will have been evaporated in existing boilers of the ordinary type before this interesting novelty, will afford any noteworthy contribution to the raising of steam at collieries and ironworks. Moreover, the possibility of this new type of boiler finding extensive employment is precluded, because it cannot be fired with coal in emergencies, and this possibility is one which must always be left open in the case of such establishments. Another reason for not making the change is that it is already possible, with existing gas-fired boilers, to obtain efficiencies which differ so little from those of the Bone boiler, that there is no inducement to incur the expense of installing and operating the high-pressure fans required for the Bone system.

Early Gas-Firing Devices.

The economical working of a gas-fired boiler is naturally dependent on the efficiency of the devices used for the admission and combustion of the gas, the boiler itself being of the same type as that fired with coal. For this reason the devices formerly used in gas firing may be first passed briefly under review. The subject is not yet so very old—at least, so far as coke-oven gas is concerned—because only since the re-introduction of the regenerative coke-oven (that is to say, at about the beginning of the present century) has this gas been available in any noteworthy amount.

The first devices for burning the gas were extremely primitive and, with certain exceptions, the usual practice was to convey the surplus gas—which was small in quantity at first and only increased with the improvements in and number of the regenerative ovens—to the boilers through simple pipes. The air of combustion was admitted in a more or less empirical manner, through a few holes cut in the end wall of the combustion chamber; and no importance was attached to regulating the air supply. At that period, the gas being regarded merely as a by-product was treated accordingly. There was a lack of devices adapted to ensure technically perfect combustion. It is evident with these modest appliances that only moderate success was attainable, and it would have been interesting to ascertain the economy of these early plants in the light of combustion tests, none of which, however, seem to have been published in the Technical Press.

Value of the Gas.

The explanation of this lack of data seems to be that until within the last few years the value of the gas remained an obscure point. If one takes as a basis merely the heat units stored up in the gas and, for, comparison, in the coal, it is found that the money value of the heat in the surplus gas from a battery of 50 regenerative coke ovens will average $25,000 per annum, or approximately 25 cents per ton of coking coal used. In ironworks the value of the blast-furnace gas is considerably higher, because the volume of gas is greater. Calculated on the basis of each ton of coke in the furnace charge, blast-furnace gas represents a money value of about $1.32, assuming the coal to be worth say $2.50 per ton, so that an ironworks consuming 150,000 tons of coke per annum will dispose of blast-furnace gas worth $198,000. In these calculations the calorimetric values alone have been taken into consideration, leaving out of account any question of the efficiency of a gas-fired boiler being higher than one fired with coal.

In ironworks, blast-furnace gas has been available in large quantities for a considerable time, and a large number of firing appliances have been tried. These mostly consisted of an external fire-box lined with fireproof material, it being considered impossible to bring the gas (which, owing to its low heating value, gave a low temperature flame) into direct contact with the boiler flue without running the risk of putting out the flame through the cooling action of the flue walls. This system, however, has been abandoned, since, given a proper construction of the device and a corresponding air supply, the flame temperature is sufficiently high to render such fears groundless. Most of the systems of firing with blast-furnace gas are of low efficiency, partly due to the considerable heat developed in the fire-box and the consequent heavy losses by radiation. In fact, Huessener calculates these heat losses as at least 10 per cent.

Efficiency of Gas Fired Boilers.

Turning to the efficiency of gas-fired boilers in general, this depends on the extent of the losses, and is, therefore, in a certain degree a function of these losses. Now the losses sustained by a boiler through radiation and in all flue gases constitute a point on which a good deal of confusion still exists, and it is therefore desirable to go rather fully into this matter, as leading up to the author's main subject, the efficiency of the gas-fired boiler.

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*From the Iron and Coal Trades Review.

The most reliable method of ascertaining the losses in steam boilers and their resulting efficiency is undoubtedly by measuring the consumption of water evaporated and fuel burned over a fairly long trial period. In the case of coal-fired boilers this determination can be carried out in a simple manner by weighing, but the exact measurement of the quantity of gas consumed in gas-heated boilers is attended with difficulties, though recently experiments conducted with gas meters have shown that the meter readings correspond with the volume of gas actually consumed. The fact may also be called to mind that the efficiency of a boiler can be calculated with sufficient accuracy from the temperature and carbon-dioxide content of the flue gas.

Useful Effect of a Boiler.

The useful effect of a boiler depends on the losses of heat by radiation and in the flue gases being kept down as low as possible. The losses by radiation can be very considerably reduced by suitable modification of the boiler; and, in fact, in many instances where gas firing is being introduced it is now proposed to provide the radiation surfaces of the boiler with an additional jacket preferably consisting of a wall half a brick thick, set up about 3½ to 4 in. from the boiler, the intermediate space being filled with slag wool. This precaution enables the losses by radiation to be minimized.

Further, the brickwork of each boiler should be given several coatings of tar, renewed every six weeks, this measure effectually preventing leakages in the brickwork, especially when the latter is examined carefully at least twice a week, any cracks found being filled up with tar immediately. Allowances of 10 per cent. for radiation in the case of flued boilers, and 5 per cent. for water-tube boilers with the usual casing of brickwork, will be approximately correct. Of course, this estimate presupposes that the boiler is being properly utilized, since the loss is not appreciably smaller for a boiler output of 2 lb. per sq. ft. than for one of twice that amount, though in the former case, the percentage loss is double that in the latter.

Ascertaining the losses of heat in the flue gases is a much more difficult matter and, as already mentioned, entails the performance of a series of measurements of the temperature and carbon-dioxide contents of these gases. It is a generally known fact that the carbon-dioxide content of the flue gases affords a measure of the excess of air on which the height of the combustion temperature depends.

It has been ascertained and confirmed by boilermakers that the useful effect of a boiler depends on the height of the initial temperature. In the case of boilers of the Lancashire type, it is calculated that 70 per cent. of the evaporation is effected by the flame tubes, 25 per cent. by the second flue and 5 per cent. by the third flue; and the proportions are probably the same in boilers of the Cornish type. Since, therefore, the temperature of combustion is one of the main factors in the absorption of heat in the boiler, we have an indication of the value to be attached to the carbon-dioxide determination, which reveals the amount of surplus air, and consequently the combustion temperature in gas-fired boilers also.

Now, whilst the activity of the makers of apparatus for measuring CO_2 has enabled the amount of that gas produced in practical working to be gauged in the case of coal-fired boilers, the question still remains in obscurity in the case of gas-fired boilers. It is well known that 13 per cent. is the smallest amount of CO_2 that should be present in the flue gases from a properly managed coal-fired boiler. On the other hand, the corresponding figure for gas-fired boilers is in many cases unknown, more particularly because it is first necessary to ascertain the theoretical percentage of carbon dioxiode from the analysis of the gas, which ascertained affords a guide for judging whether the actual CO_2 value found in the combustion gases should be regarded as favorable or not.

Gas Firing Economy Requirements.

Reverting to the economy of gas-firing, the first main requirement to be fulfilled is that combustion must take place at the immediate point of entry of the gas. This is evident, because the heat absorption and therefore the economy of a boiler is entirely a question of the fall in temperature utilized during the passage of the heating gases from one end of the boiler to the other. Some gas consumers are satisfied with the fact that a bright flame is observed throughout the whole length of the boiler flues; but such a fire is as wasteful as it possibly could be, because, since the combustion is going on up to the end of the boiler flues, the temperature there is still too high for any considerable amount of heat to be absorbed in the flues, and, consequently, the heating gases pass away at a high temperature and imperfectly utilized.

It may here be stated that it is disadvantageous to mount the gas burner, as is often done, inside the boiler flue, because in such case the heating effect of the gas does not commence for the first three feet or so from the intake end of the flue, and about 10 per cent. of the flue or about 7 per cent. of the total useful heating surface, is inoperative so far as heat absorption is concerned. It is advisable to mount the burner a sufficient distance further back —using an intermediate member if necessary—so that combustion is able to commence immediately at the intake end of the boiler flue.

The Bunsen burner is the only type which gives perfect combustion immediately beyond the point of entry of the gas, and there is no doubt that the Bunsen principle cannot be improved upon or surpassed in any way. Just in the same way that the heating effect of the Bunsen burner is based on the gas and air being brought together at such an early stage, and, therefore, so intimately mixed that combustion is accompanied by the well-known bluish, completely non-luminous flame, the economy of gas-firing also depends on the combustion being effected with a non-luminous flame.

Now that every gas fire is constructed so as to correspond with the principle of the Bunsen burner, it is necessary, in the interests of economical management of the gas, that this condition of a high heating effect should be fulfilled in all circumstances, in view of the extremely large quantities of gas in constant use for steam raising. In the case of boilers fired with coke-oven gas, in particular, too little importance is attached to having a non-luminous flame; and this is the more remarkable because it is just in the case of this kind of gas that a glance into the boiler will show clearly whether the burner is giving a non-luminous Bunsen flame or a bright flame. As the corollary to these observations, the requirements which economically-worked gas firing for boilers should fulfill will now be summarized.

Economy Requirements Summary.

Gas firing must be characterized as the most perfect of all systems, since it alone enables absolutely perfect combustion to be obtained by restricting the excess of air to a minimum and thus giving the highest useful effect. All that is necessary is to measure the air supply so that, on the one hand, the gas combustion is complete, and takes place immediately at the point of entry, and, on the other, all needless excess of gas is precluded. The points to be taken into consideration in constructing an economically-operating gas fire for boilers are, therefore, as follows:—

1.—The air of combustion or a portion of same should be brought into contact with the gas at such an early stage that an intimate mixture of gas and air is produced by the time they reach the seat of combustion, and that complete combustion and maximum flame temperature are attained at once and within a minimum distance.

2.—The air supply must be arranged in such a way that the amount of air necessary for complete combustion enters independently of the chimney draught, whilst the velocity of the gases can be lessened by throttling the chimney damper, in order to lower the temperature of the flue gases as much as possible, without fear of unduly lessening their air supply.

The first point is settled in quite an ideal manner by means of the Bunsen-burner principle, which enables the combustion temperature to be approximated to the theoretical standard.

The second point is also of extreme importance. As already stated, the heat absorption of a boiler is solely a question of time, since the velocity of the gases of combustion must be regulated so that as much as possible of their contained heat can be allowed sufficient time to be absorbed by the walls of the boiler. The only way in which this condition can be satisfied is by making the combustion practically independent of the chimney draught. When the air of combustion is drawn in by the suction of the chimney, it is necessary to keep the damper wide open in order to secure the admission of sufficient air for the combustion of the gas. This means, in other words, that under the influence of the chimney draught the products of combustion pass through the boiler quickly and enter the chimney flue at a high temperature.

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ENGINE AND BOILER PACKING MARKET.

THE following statement from the British Board of Trade shows for a recent year the value of engine and boiler packing exported from Germany, Austria-Hungary, and the United Kingdom, respectively, to the principal colonial and neutral markets to which the two first-named countries send such goods:—

Country to which Exported	From Germany 1912.	From Austria 1913.	From U.K. 1913.
	£	£	£
British India	1,800	650	30,600
Norway	6,350	140	6,500
Sweden	6,850	20	6,100
Denmark	5,200	290	4,100
Netherlands	17,150	4,560	7,600
Belgium	17,100	2,430	10,600
France	11,100	7,760	12,400
Switzerland	8,700	1,530	300
Spain	6,350	430	3,700
Italy	12,900	1,880	2,200
Servia	500	280	——
Roumania	2,800	930	900
Russia-European ...	12,300	12,080	5,700
Turkey-European ...	900	1,150	2,400
Turkey-Asiatic		150	2,400
Egypt	1,300	410	4,800
Dutch East Indies ..	2,150	50	[illegible]
Japan	3,000	10	5,600
Argentine	10,700	270	10,100
Chile	2,900	160	9,400
United States	11,250	2,300	
Total	£141,300	£38,480	£134,800

The foregoing figures show that while the United Kingdom holds a strong position in the Indian, Egyptian, Chilean and United States markets, the position is less strong in the remainder. In Norway and Sweden the trade is about equally divided between the United Kingdom and Germany, but in the remaining European markets specified, and in the Dutch East Indies, there is room for considerable expansion in the sales of British made engine and boiler packing.

Principal German Markets.

The following additional information is available as to the principal markets to which piston packing, stuffing-box packing, luting cords, and Klingerit boiler jackets, calking slabs, calking rings, etc., of asbestos, of asbestos paper or asbestos tissues were exported from Germany in 1912, and the value of the exports sent to each:—

Countries to which exported.	Piston packing, stuffing-box, packing, luting cords.	Klingerit boiler jackets, calking slabs, calking rings, etc., of asbestos, of asbestos paper or asbestos tissues.
	£	£
British India	1,500	300
Norway	3,300	3,050
Sweden	4,350	2,500
Denmark	3,150	2,050
Netherlands	10,850	6,300
Belgium	6,100	11,000
France	4,600	6,500
Switzerland	5,050	3,650
Spain	3,650	2,700
Italy	4,500	8,400
Servia	400	100
Roumania	1,600	1,200
Russia (European)...	5,500	6,800
Turkey (European and and Asiatic)	650	250
Egypt	1,000	300
Dutch East Indies ...	1,7500	400
Japan	2,700	300
Argentine	6,700	4,000
Chile	2,100	800
United States	1,750	9,500
Total to above markets	£71,200	£70,100

The aggregate value of German exports of engine and boiler packing to the above markets amounted to £141,300, or 70 per cent. of Germany's exports of such goods to all destinations.

Summary.

The aggregate value of the German and Austrian export trade in engine and boiler packing which might be recovered by British and colonial manufacturers may be summed up as follows:—

(a)—In the United Kingdom market:—	
German Trade (1912):	£
Piston packing, stuffing-box packing, luting cords	12,450
Klingerit, boiler jackets; calking slabs, calking rings, etc., of asbestos, etc.	14,150
Austrian Trade (1913):	
Engine packing of rubber	16,780
Total	£43,380*
(b) In Colonial and Neutral Markets:—	
German Trade (1912):	
Piston, packing, stuffing-box pack-luting cords	71,200
Klingerit boiler-jackets, calking rings, etc., of asbestos, etc.	70,100
Austrian Trade (1913):	
Engine packing of rubber	38,480
Total	£179,780*

or a grand total of £223,160.

The following further particulars are available as to the imports into the South African and Australian markets:

Australia.

The value of the imports of asbestos and other packings into the Commonwealth of Australia during 1912 according to countries of origin was:—

	U.K.	Austria-Hungary.	Germany.	All Countries.
	£	£	£	£
Asbestos and other packings (except in rope form) including asbestos cloth (with or without wire), proofed with rubber; asbestos cord; boiler covering; asbestos mattresses for boilers.	21,469	3,469	4,985	42,724
Engine packing in rope form, other than asbestos.	1,951	80	104	3,374
Totals	£23,420	3,549	5,089	46,098

It will be observed that although the United Kingdom contributed over one-half of the total imports, Germany and Austria-Hungary secured between them a not inconsiderable share of the total trade, which British and Colonial manufacturers have the opportunity of capturing.

South Africa.

The following are the particulars of the value of the imports of engine packing into the Union of South Africa during 1911, 1912 and 1913:—

Countries of origin.	1911.	1912.	1913.
	£	£	£
United Kingdom	18,399	19,143	17,308
Austria-Hungary	482	504	395
Germany	5,171	3,846	4,899
All Countries	42,938	38,726	36,386

It will be observed that the total imports showed a decline in 1912 and 1913. Imports from Germany were, however, over 27 per cent. greater in 1913 than in 1912, whereas those from the United Kingdom showed a decrease of 10 per cent.

*The German figures for 1912 and the Austro-Hungarian figures for 1913 have been added so as to give an idea of the trade in a year.

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E. Laurie & Co., Montreal, have received an order from the City of Montreal for a 24,000,000 gallon steam turbine driven pump to be made by the De Laval Turbine Co., Trenton, N.J. The pump will cost $47,000, and is to be delivered by next April.

Regina, Sask.—The new power house is rapidly nearing completion. The cost of the building will be approximately $170,000; the cost above ground level being $90,000, in addition to $36,000 for steel. The foundations and ground floor were constructed by the city by day labor at a cost of about $40,000. Up to the present time nearly $100,000 worth of machinery has been installed.

Data Relative to Steam Boiler Defects and Failures--VI.

Through the courtesy of the Vulcan Boiler & General Insurance Co., Ltd., Manchester, England, we are enabled to lay before our readers a record of Continental Europe practice and experience relative to defects met with by the Steam Boiler Inspection Association of Brussels, Belgium. The descriptive matter and illustrations go into minute detail, and are non-technical, making the educative feature interesting and easy of appropriation.

THE present article deals with boiler defects and failures arising from flaws and laminations in plates, internal corrosion by oxygen from the air, and internal corrosion due to acid feed water. All of these contingencies have to be met in the operation of steam power plants; therefore, the variety of data given becomes at once interesting and instructive.

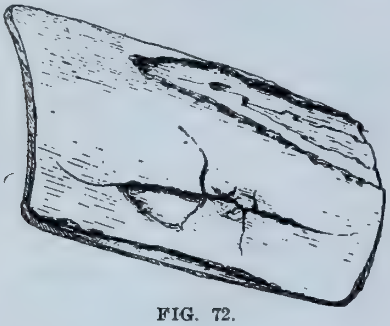


FIG. 72.

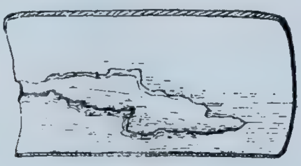


FIG. 73.

Flaws and Laminations in Plates.

Fig. 72 shows a piece of the furnace plate of a boiler with feed heaters. It is divided into two layers of practically the same thickness. The outer layer was overheated, bulged, and finally fractured at different points.

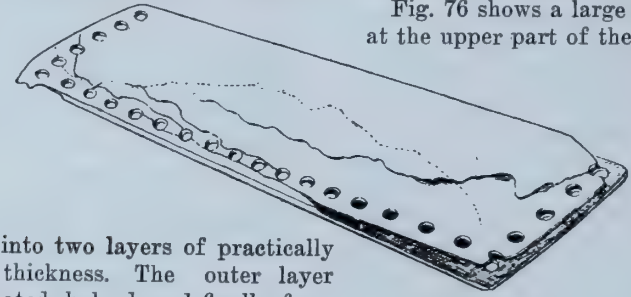


FIG. 76.

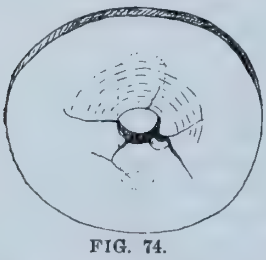


FIG. 74.

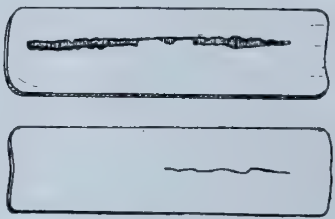


FIG. 77.

Fig. 73 shows a bad flaw in the furnace plate of a drum. The plate was 10 m.m. thick and the two layers were practically equal. The plate was fractured on the inner side; the outer layer being bulged upwards and developing some cracks.

Fig. 74 illustrates a flaw in the steel furnace plate of a boiler with feed heater. When the presence of the flaw was first noticed, a large rivet was fixed at the centre. As a result of this the flaw naturally extended and the outer layer fractured.

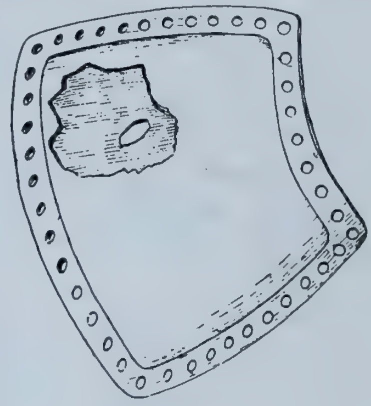


FIG. 75.

Fig. 75 refers to a flaw in a lap of one of the end plates of an old boiler with drums. The outer layer which was fractured comprised more than half of the thickness. The end plate also shows corrosion accentuated by the gases.

Fig. 76 shows a large flaw commencing at the upper part of the plate of a boiler with single shell. The plate divided into two principal layers, and further shows signs of a series of other layers as yet not fully developed. The plate was badly welded.

Fig. 77 illustrates a flaw bulged on the inner side and of which the outer layer is fractured. The fracture occurred shortly after cleaning, at which time and before the boiler was set to work its interior was smeared with oil, hence the overheating which has caused the bulging of the unsound spot.

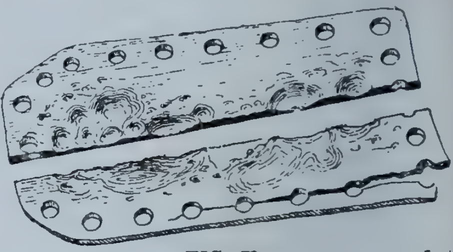


FIG. 79.

Internal Corrosion by Oxygen of the Air.

Fig. 78 shows the shell ring from the feed heater of a boiler fed with river water; age, 12 years. The original thickness of the plate was 8 m.m. The lower part and the sides were severely pitted and the corroded spots spread and finally became joined together, so that in places the corrosion was almost uniform. The thickness was reduced to 3 or 4 m.m., and at certain parts of the edge to nothing. The edge of the plate was also attacked in places, and the lap joint reduced. On the sides, the cor-

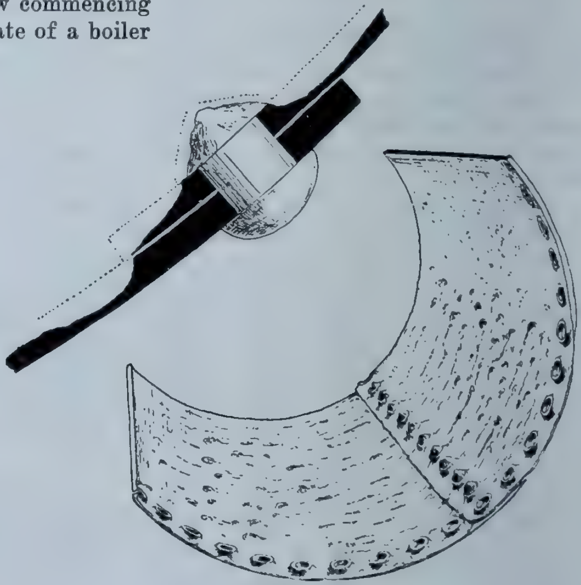


FIG. 78.

rosion is practically uniform. In addition, a certain number of vertical corroded grooves were noticed. At the bottom, the pitted spots spread and joined together, but at the upper part the pitted spots were few.

Fig. 79 illustrates a piece attached to the lower part of the end of one of the divided drums of a boiler. At the part in question, the plate was protected by brickwork. The cold feed water was delivered to the bottom of the shell at the end, and thus ran directly into the drums, while air had access to the parts not heated. The plate presents a series of large and very deep pitted holes, and at one point is corroded right through.

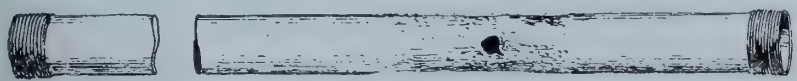


FIG. 80.

Fig. 80 shows stay tubes from a vertical boiler with smoke tubes, which was severely corroded about the usual water level. The boiler was frequently out of use, and it is probable that the corrosion occurred at these times. The external diameter is reduced from 65 to 51 m.m.

Internal Corrosion by Acid Feed Water.

Fig. 81 is a piece of a Morrison corrugated flue tube taken from a boiler with two internal furnaces; age, 18 months. At first the boiler was fed with water contaminated by traces of hydrochloric acid. At the end of a year, the presence of some blotches of corrosion, 3 to 4 m.m. deep, were observed. Following that time the boiler had been used for making concentrations of chloride of zinc, and sometimes chloride of lead had been introduced into it. This with the sulphate of lime contained in the feed water produced sulphuretted hydrogen in large quantities, hence the corrosion. The crusts adhering to the tube show the presence of sulphuretted hydrogen. The tube retained its original thickness of 12 m.m. at the lower part, but the portions subjected to heat were severely corroded, and the wasting attained its maximum a little above the grate, where the thickness was reduced to nothing. Happily, the boiler only worked at a pressure of one atmosphere.

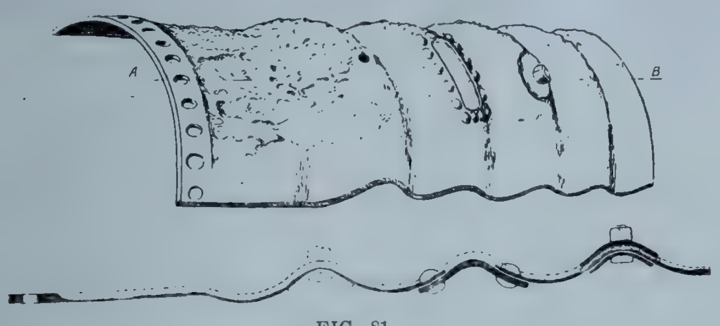


FIG. 81.

TREATMENT OF BOILER FEED

THE presence of carbon dioxide in the boiler feed water cannot be considered objectionable as a rule, but where the process of corrosion of the boiler sheets has already started it may accelerate it, says Professor Blacken of Riga. It can, however, be easily removed by caustic soda. Air must be considered as a harmful agent, since the protective action of oxygen in boiler practice has been neither observed nor proved. The air in the presence of chlorides and under certain conditions causes dangerous spot corrosion, and, since it is due to the action of the oxygen of the air mechanically carried into the boiler with the feed water, it is advisable to take care to admit as little as possible.

It is very desirable to admit the feed water either into the steam space or closely below the water level, so as to permit the air to escape into the steam. If there be a large amount of chlorides present in the water, it appears advisable to reject such water entirely, but, if not, it is well to observe the inside of the boiler very carefully, and as soon as signs of corrosion appear, to install zinc plates in metallic connection with the boiler shell, taking care, however, to see that as little as possible of air is allowed to enter, since otherwise the oxygen will in a very short time destroy the zinc. As regards the organic constituents, Reischle, of Munich, discusses particularly the action of various tar, asphalt and graphite paints, and mentions the Brun process, widely used in Switzerland, which consists in the addition to the boiler water of some linseed oil. On the whole, he comes to the following conclusions with respect to the use of means for preventing scale:

They prevent more or less formation of scale, but cannot be considered as a certain method of protection, with the exception, perhaps of the above-mentioned Brun process they produce solution of old scale only occasionally, but usually make it brittle so that it either breaks off itself or can be more easily removed. Sometimes the application may lead to overheating and injurious results to the boiler plates, especially the firebox plates, and finally, they can produce clogging of the water gauge glass and blow-off cocks.—Journal A.S.M.E.

REPORT ON BOILER EXPLOSION,

THE Department of Public Works, Province of Ontario, has issued through its Steam Boiler Inspection office, the following report covering the explosion of a portable agricultural type boiler at Kincardine, Ont., on September 11 of this year.

Description of Boiler.

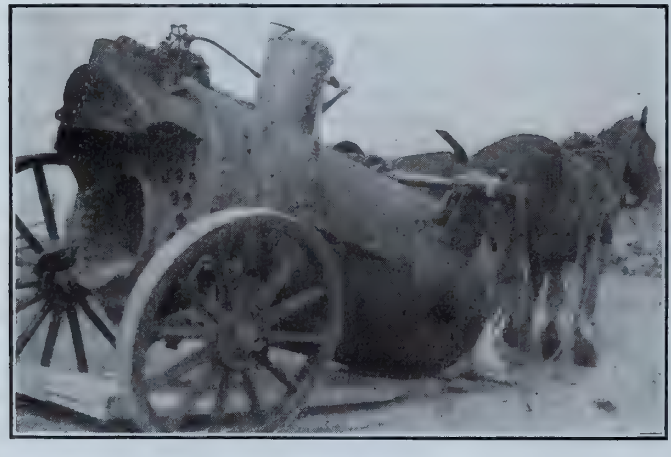
The boiler, as already stated, was of the portable agricultural type, with internal furnace, and rated at 10 or 12 horsepower. The shell, constructed in one course, was 39 ins. in diameter by 6 ft. 6 ins. long, of 5-16 in. plate with longitudinal seam, double riveted lap; the rivets being 5-8 in. diameter by $2\frac{3}{4}$ in. pitch. The heads were 5-16 in. thick, and the circumferential seams had $\frac{5}{8}$ in. diameter rivets of $2\frac{1}{8}$ in. pitch. The rear head was stayed to the combustion chamber head by $\frac{3}{4}$-in. screw stays pitched at 6 ins. by 6 ins. maximum. The furnace consisted of one course 21 ins. diameter, 60 ins. long. $\frac{1}{4}$ in. plate with longitudinal seam single riveted lap, and $\frac{5}{8}$ in. rivets, $2\frac{1}{4}$ in. pitch. The tubes were $2\frac{1}{2}$ in. diameter and numbered twenty-three. The segments above tubes were stayed by two 1-in. through stays. The boiler mountings were of the usual type, the safety valve diameter being $1\frac{1}{2}$ ins. This was manufactured by the Consolidated Valve Co., Connecticut. A single-cylinder horizontal engine was mounted on top of the shell and the outfit was manufactured by L. D. Sawyer & Co., Hamilton. The date of manufacture was not obtainable.

Condition of Boiler After Explosion.

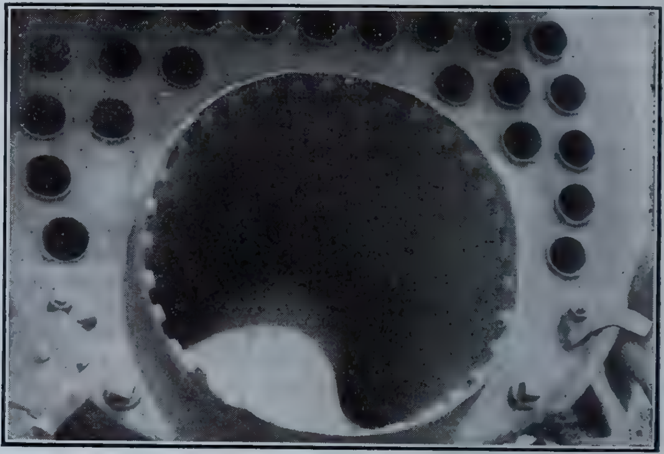
The furnace had ruptured and collapsed about three feet from the front end, tearing circumferentially. The longitudinal seam was on the bottom of the furnace and the rupture passed through the centre of a rivet-hole. The bottom half of the furnace at the point of failure was forced up to the crown and was torn about half way around the circumference. The plate was wasted around the mouth of the furnace to a knife edge in many places and pitted and corroded generally to a material depth which could not be gauged owing to the condition of the furnace at the time of inspection. The engine and mountings were all smashed more or less, with the exception of the safety valve, which was intact. The steam gauge dial was missing, but the movement, which was of the double tube type, was not damaged, and appeared to be in sound working condition.

Remarks and Conclusions.

The explosion was undoubtedly due to the failure of a furnace weak in construction and weakened and impaired by age and corrosion, and altogether totally inadequate to withstand the working pressure of 100 pounds per square inch carried at the time of the accident. Owing to the nature of the collapse, the thickness and condition of the metal at the ruptured part could not be ascertained without the furnace being removed. The safety valve was tested after the accident and a report of this test from Hergott Bros., Mildmay, shows that it released at 110 pounds per square inch.



ASSEMBLY VIEW OF PORTABLE ENGINE AND BOILER



VIEW OF RUPTURED FURNACE.

The boiler was blown by the reaction of the explosion about 100 feet from its original location through the woodwork of a barn, causing considerable damage to property and the loss of the owner's life, Samuel Lindsay, besides inflicting very serious injuries to the deceased man's father and another victim, a farmer, who was assisting to run the threshing machine at the time of the disaster.

It is obvious that this fatal explosion could have been avoided had the boiler been examined by a competent man and the working pressure fixed in accordance with the strength and condition of the boiler structure. The boiler had only been in operation at the already mentioned farm for a very short period and had been previously purchased in a second-hand condition from some person in this line of business.

We are indebted to D. M. Medcalf, chief of Boiler Inspectors' Department, Province of Ontario, for the report and photographs.

STEAM BOILER MAINTENANCE AND INSPECTION.

WHAT follows is an abstract from a paper by H. A. Baumhart of the Hartford Boiler Inspection & Insurance Co., of Cleveland, O., read before the annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers.—

Great progress has been made in steam boiler design and construction during the past twenty years. In fact, there are but few, if any, boiler manufacturers who would to-day construct a boiler for a given pressure without taking into consideration safe rules as adopted by provinces and municipalities or as recommended by good steam engineering practice.

Retiring Age for Boilers.

The subject of a proper retiring age for old steam boilers is one which comes frequently to light and is a most fruitful source of controversy. Of course there can be no question as to the propriety of condemning to forced retirement those boilers whose diseases of one sort or another have reached the chronic stage, and are no longer curable, but there is at once the basis for a deal of argument when an inspector approaches the owner of a boiler with the statement that it must be replaced because of old age, especially if it is known to have all the apparent qualifications, except youth, for many additional years of service.

In the past many curious properties have been attributed to old boilers; one of the most interesting was the notion that they could not explode violently. It was supposed that an old boiler would merely rupture, allowing the pressure to be relieved much as if the safety valve had opened. This idea was definitely disproved many years ago along with many other fallacies and much popular mystery concerning boiler explosions.

Service Deterioration.

We all know that steel used in boiler construction will deteriorate with use. It undergoes a slow loss in strength and ductility. The process is hastened by the presence of a moderate excess of phosphorus. Deterioration of this character cannot be determined by the usual method of inspection. It is, therefore, difficult to state definitely at what time in service the boiler should be abandoned. It places a great responsibility upon the inspector. He must consider, in addition to the general appearance of the boiler, the conditions under which it has operated, and he must also make allowance for defects in the material which are not visible.

Experience shows that boiler plate, subjected to the high temperature of the furnace, does deteriorate to the extent that after about 20 or 25 years' service, the boiler should (if we follow the motto "Safety First") be taken out of service. Because an inspector reports that he considers the boiler unsafe for further use, it does not imply that he can predict the day and the hour when it will explode; it does mean, however, that the factor of safety is too low, and to continue the boiler in service for any considerable length of time presents a hazard too dangerous to be undertaken.

Boiler Explosions.

No mysterious agency enters a boiler to cause an explosion. A steam boiler explodes or fails from one cause only, and that is the fact that the boiler or the part which fails could no longer resist the strain placed upon it. The applied pressure may be sufficient to rupture a sound boiler, or the boiler may have reached such a state of deterioration that the ordinary working pressure becomes an over-pressure. In the majority of serious explosions, the primary cause was due to the lap seam form of construction.

Many accidents are due to overheating of the shell plate or tubes. The overheating may result from various causes. The common cause is due to a deposit of scale, sediment, oil, or a combination of oil and scale on the internal surfaces.

The presence of oil or grease, although in moderate amounts on the internal surface of a shell plate or tube, is a dangerous condition, and, unless removed promptly, will result in a damaged or possibly an exploded boiler. Great care should be exercised to prevent oil entering a boiler.

By referring to the records of the Hartford Steam Boiler Inspection and Insurance Co., I find the following data given in Table I on boiler explosions for the United States during 1911-13.

TABLE I.—DATA ON BOILER EXPLOSIONS IN UNITED STATES, 1911-13.

	Boiler	——Persons——		
Year.	explosions.	Killed.	Injured.	Total.
1911	499	222	416	638
1912	537	278	392	670
1913	499	180	369	549

The annual property damage is estimated at $500,000. The above records include boiler accidents of every description, some of which were of minor importance. This record is not an alarming condition and, in fact, we are very much encouraged because of the great interest now taken by engineers everywhere insisting upon proper construction and inspection of steam boilers. In many localities compulsory inspection is required by law. The situation therefore as regards safety is gradually improving.

We have not reached the stage of no boiler accidents. Such a condition will never exist. There will be boiler explosions as long as steam boilers are used as a unit of power. We have not yet reached the stage of perfection in the manufacture of material, neither have we reached perfection in the art of boiler design. We learn as much from the result of failure as from the result of success. Further experiences in the operation of steam boilers may teach us that some radical change in design or character of the material is required.

Care and Management.

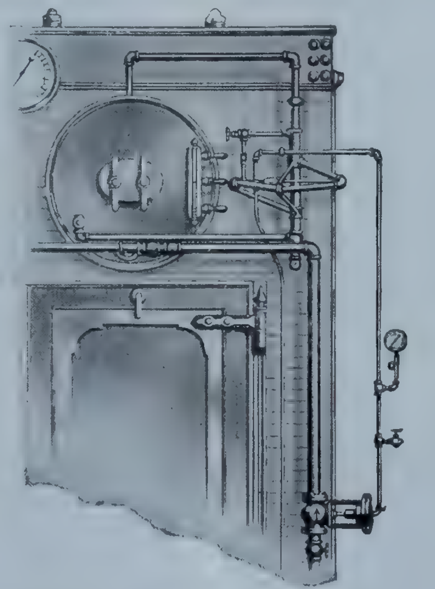
Another condition which must be considered in connection with the safe operation of steam boilers is their care and management. It frequently happens that a boiler explosion, or some other calamity resulting in loss of life, occurs at places where it is least expected. This proves that, in spite of the advanced precautions that science has provided, reliance must still be placed in human intelligence and faithfulness to a large degree and that sometimes these fail.

It is recommended that boiler owners and users provide every possible method of safeguarding human life and property by purchasing only such boilers as have been thoroughly inspected during course of construction and by seeing that they are also inspected during the life of the boilers. It also devolves upon the owner or user of a boiler to select only such persons as are fitted to care for them.

BOILER FEED WATER CONTROL

IN the boiler feed water controller here shown installed on a Babcock & Wilcox boiler, the main feed valve is handled by direct boiler pressure, making it positive in all its operations. This is made possible by the introduction of the auxiliary valve, for the successful operation of which a movement of not over 1-64 inch is required; this motion being automatically produced by the expansion and contraction of the copper tubes composing the harp.

There is a heavy cast water-column connected at top and bottom with corresponding points of the boiler, the middle point of the column being placed at the height of the true water line. The top and bottom of the column are connected externally by a series of heavy copper tubes called the harp, the extreme ends of these tubes being connected in a straight line as shown. This connecting link contains the mechanism by which the force exerted by the expansion or contraction of the copper tubes is utilized. It consists of the auxiliary valve with three ports and a single seat, connected to one end of the harp by the stud end of the pilot, the valve seat being connected with the other end of the harp by two rods which are linked together by a turnbuckle. The port for the pressure supply to feed valve is connected by the pipe with the regulating valve which controls the water supply from pump. The operation of the auxiliary valve is affected as follows:—



BOILER FEED WATER CONTROL.

Steam from the harp column enters the pilot valve and it met by the resistance plug, which is 1-64 inch less in diameter than its chamber. Through this slight opening, enough steam escapes (through port for pressure supply to feed), to soon build up sufficient pressure on top of the diaphragm and closes valve. This shuts off the water supply completely. Evaporation continues in the boiler and the water line falls. Steam then fills a larger proportion of the copper harp than before and causes it to expand still further. This exerts a pull which unseats the auxiliary valve, opening the exhaust port which leads to the air. Pressure on the diaphragm is at once relieved (through exhaust port), and the valve is opened by the spring. Communication with the pump being established, the water line rises; the harp becomes cooled and contracts, the auxiliary valve is closed and the exhaust through exhaust port ceases, while the steam which seeps past the plug builds up pressure again and closes the regulating valve, cutting off the water supply.

The illustration accompanying this article shows the Squires boiler feed water controller, for the use of which we are indebted to the Canadian Allis-Chalmers Ltd., Toronto.

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HONEYCOMB AND CLINKER FORMATION IN FURNACES.

PROFESSOR S. W. PARR, of the University of Illinois, in a paper on "Honeycomb and Clinker Formation in Furnaces," read before the Convention of the International Railway Fuel Association, came to the following conclusions:

1.—The chemical condition which seems to be most conducive to formation of honeycomb is that in which the percentage of iron pyrites is high.

2.—Any conditions in the combustion chamber which by reason of the time interval for complete oxidation, or temperature stages, or deficiency in oxygen, which would promote the formation for any brief length of time of the iron pyrites in the ferrous sulphite or "halfway" stage, is a condition likely to promote clinkering.

3.—The physical condition most active in promoting the formation of clinkering of particles in the fire-box above the grates is found in the finely divided material—coming from the floor of the mine—which is both high in ash and high in iron pyrites.

4.—At least one practical suggestion is indicated, namely, that so far as is possible the fine stuff be eliminated from the material as fired. Material of this sort may be much more readily handled in fires which are not conducted under such forced conditions as to draught and speed of combustion, it being only necessary to allow ample access of oxygen until the time of complete burning out of the sulphur, after which the tendency to fuse is reduced to the minimum.

Steam Engines and Auxiliaries

BREAKDOWN OF QUICK-REVOLUTION ENGINE.

AMONG the many breakdowns that have come under the supervision of the Vulcan Boiler & General Insurance Co., Manchester, England, one of the most interesting of these is a case of a high-speed engine that failed owing to an abnormal acceleration of the speed. Through the courtesy of the above concern, we are enabled to reproduce several photographs of the breakdown, and give some general particulars relative to the occurrence.

The engine was of the inverted vertical compound type, with cylinders 12 in. and 20 in. diameter by 8 in. stroke. It ran at 430 revolutions per minute, and was coupled direct to a dynamo. The condensing apparatus was separate and driven by an electric motor. Without the slightest warning the speed suddenly increased and almost immediately after the engine was wrecked.

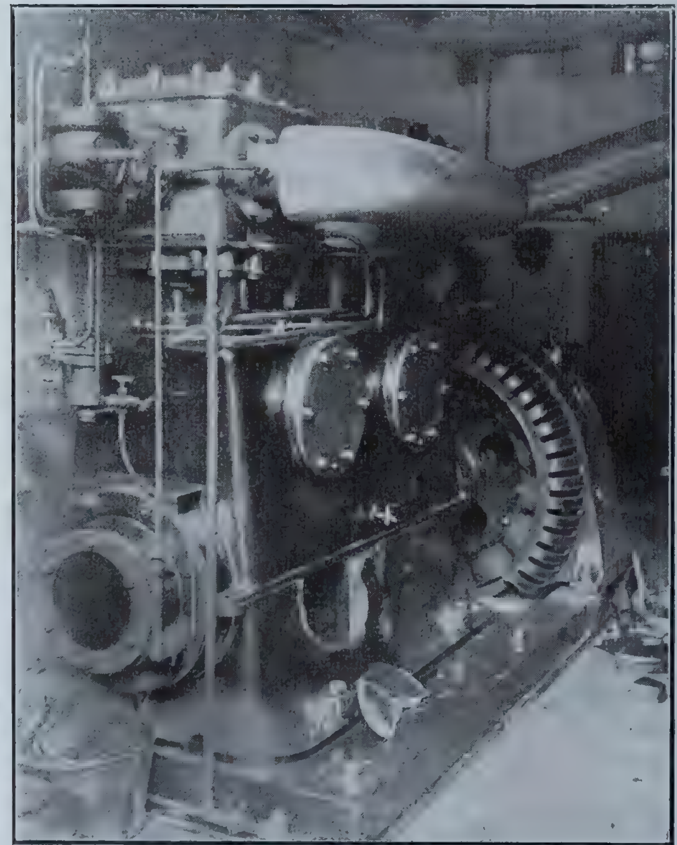
When the parts were dismantled, it was found that both balance weights had been flung off, with the result that the low-pressure cylinder was smashed along with the distance piece and cover, while the frame on this side was seriously fractured and the door broken. On the high-pressure side, the balance weight was thrust into the base plate, and a large piece broken out. The low-pressure connecting rod was badly bent, and the piston with its rod broken.

Defective Throttle Valve the Cause.

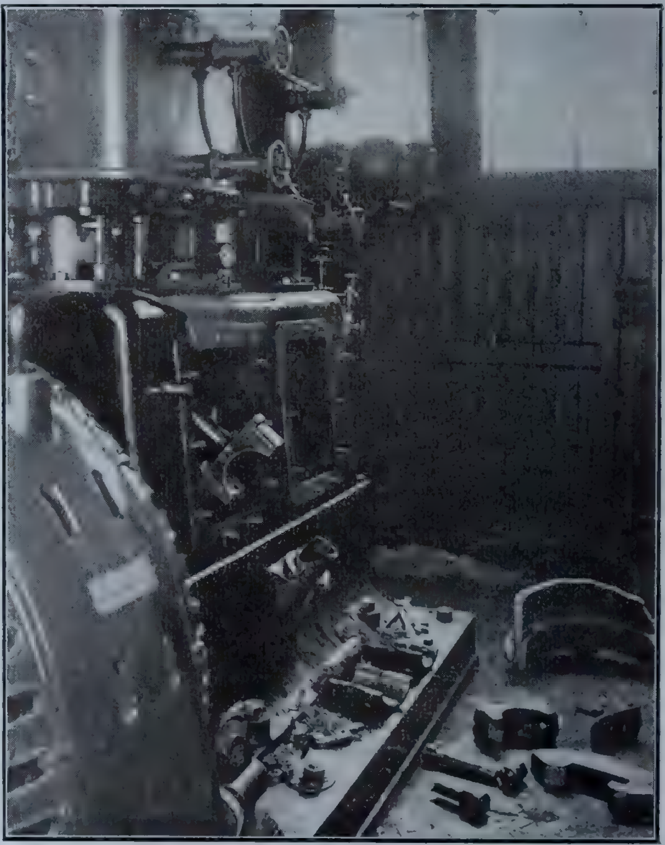
As can be imagined, considerable damage was done to the gear and other details of the engine, with the result that it had to be lifted entirely out of its place and taken to the makers for reconstruction. The question as to how the engine ran away naturally concerned the Vulcan Co., with whom it was insured, and on investigation it was found that the accident was due to a defective throttle-valve which was of the double-beat equilibrium type.

The wings of one of the valves were too short, so that when the valve was opened by the action of the governor at full load, it was almost withdrawn from its seat. Owing to its repeated movements in this position, the tips of the wings got worn and, it would appear that eventually, during some short period of extra heavy load the valve must have slipped out of its seat entirely and got jammed full open. When the load diminished the quantity of steam passing would, of course, be greatly in excess and cause racing of the engine. The governor, which was of the crank shaft type, had evidently endeavored to check this by throwing out its arms, for one of the bell crank levers which carried the weights was broken off.

Although it is seldom the breakdown of a high-speed engine is brought about in this way, still the one in question shows its possibility, and emphasizes the necessity of careful inspection of the smallest details when engines are in

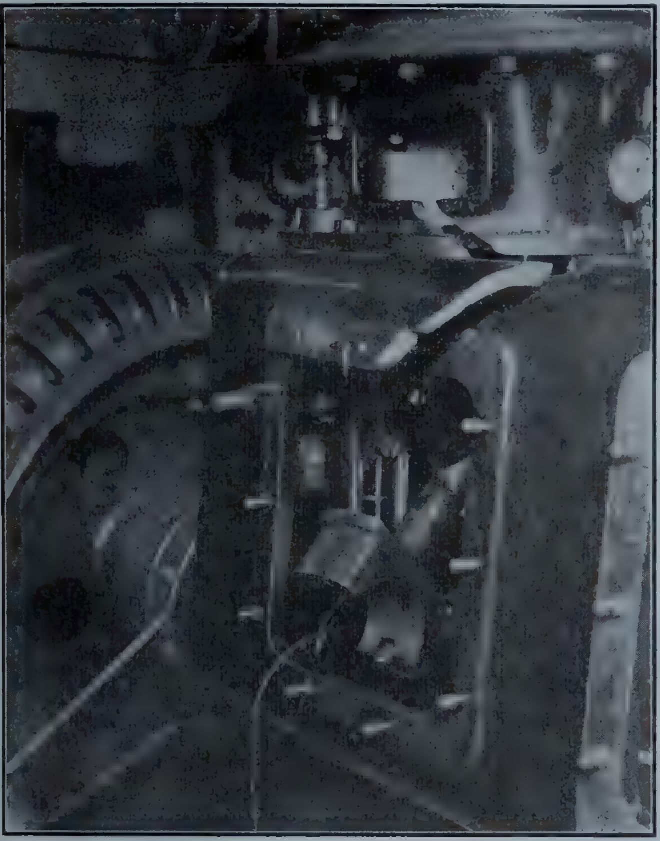


BREAKDOWN OF HIGH-SPEED ENGINE, SHOWING AT REAR L. P. BROKEN CASING.

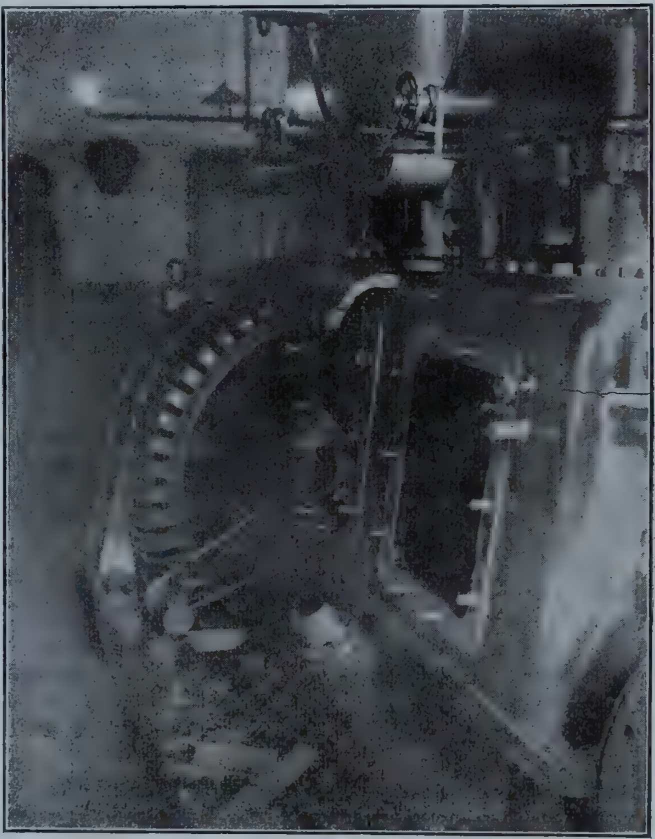


BREAKDOWN OF HIGH-SPEED ENGINE, SHOWING L. P. CYLR. TOP, BALANCE WEIGHTS, ETC., ON FLOOR.

course of construction. The experience of the Vulcan Co. shows too frequently that it is the unexpected which happens, and that primary inattention to small details often leads to serious breakdowns and costly repairs afterwards.



BREAKDOWN OF HIGH-SPEED ENGINE, SHOWING DETAIL OF L. P. BROKEN CASING.



BREAKDOWN OF HIGH-SPEED ENGINE, SHOWING ANOTHER VIEW OF L. P. BROKEN CASING.

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TURBO-GENERATORS FOR HIGH OUTPUTS AND SPEEDS.

By W. Kieser.

THE frequency of the alternating current supply adopted in most countries makes it essential to select the maximum speed of 3,000 revs. per min. for turbo-generators, or one-half of this figure for the next lowest frequency—that is, 1,500 revs. per min. In view of the great difference in the amount of material required to ensure the same steam consumption at these two speeds, keen competition has existed for some years in generator and steam turbine construction, with the object of producing a machine giving the largest possible output when running at a speed of 3,000 revs. per minute.

The output of the generator has been increased from year to year, chiefly by improving the ventilation of the machine, and by the more favorable distribution of the magnetic or current-carrying material. The progress made in the manufacture of the constructional materials has also contributed towards an increase in the outputs. It has been possible to carry out this increase without endangering the reliability of operation in any way.

The increase in the unit output of the steam turbine has also been accompanied by an increase in the size of the generators. The difficulty, however, in steam turbine construction lies in the fact that the quantity of steam which has to flow through the turbine attains a volume in the last low pressure stage corresponding to the available vacuum, which is too large for turbines of the customary construction. Two ways of solving this question present themselves. The high pressure stage has only a partial admission, while the diameter of the next runner is so selected that the resulting section of the steam passage through the blades has a given value, and therefore the blades themselves, do not fall below a certain minimum length. A dependence further exists between the output of the machine, or in other words, the available quantity of steam, and the ring surface over which the steam flows through the wheel.

At larger outputs also (always under the assumption that the speed $n=3{,}000$) a proportionately smaller diameter is thus obtained for the runners following the high pressure section, so that in consequence of the comparatively low peripheral speed for this part of the turbine, it is necessary to select a low steam velocity. The small runner diameter, however, will not permit the necessary quantity of steam to pass through the last low pressure stage with a good efficiency when the vacuum is high. Thus, even when the blades are constructed as long as possible, it is necessary to select a much larger diameter and higher steam velocities for the last runner. For this purpose the runner must be specially rigidly constructed in order to give it the necessary strength.

The second solution is found in the employment of two wheels placed in parallel in place of the last low pressure runner, independently of the size of the runners following the high pressure section; it is then necessary to make special provision for diverting the steam from the runner next to the end one to the latter of the two wheels forming the last stage.—A. E. G. Journal.

* * *

101 PER CENT. VACUUM.

WITHIN recent years, engineers have been striving for higher and higher vacuums, but it is only recently that the feat of obtaining a vacuum 1 per cent. higher than the theoretical has been accomplished. A recent test made in the hydraulic laboratory of the Wheeler Condenser & Engineering Co., Carteret, N.J., on one of their turbo air pumps, showed vacuums considerably higher than the theoretical for quantities of air up to about 20 cu. ft. of free air per minute when the vacuum fell to the 100 per cent. or the theoretical.

An explanation advanced of the phenomenon by the company's engineering department, is that the hurling water passing through the pump is subjected to a cooling effect caused by the high vacuum and this reduces the temperature of the water, also reduces the vapor tension and increases the vacuum obtainable.

* * *

LOCOMOTIVE MECHANICAL STOKERS

THE report of the Committee on Mechanical Stokers read at the forty-seventh annual convention of the American Railway Master Mechanics' Association was in part as follows:—

The development of the locomotive stoker continues, though nothing notable has been observed during the past year. In the committee's last report allusion was made to the apparently accepted utility of the device, and its adaptability to locomotive service. References were also made to the higher average steam pressures maintained, and especially toward the latter part of a division run, simplicity of operation, work performed, etc. The belief was expressed that most of the statements appearing in their last report have been borne out in practice, according to such observations as the additional year has permitted. In last year's report it was pointed out that the several types were, in the main, divided into two general classes—namely, the underfeed and the scatter or overfeed types, but, up till last year, no opinion was advanced as to which type will, in the end, prevail.

The committee again made reference to the difficulties surrounding the design of a machine to suit present locomotive construction; not so much an account of the work to be performed, but the absence of choice as to arrangement, the absolute limitations of space, and the conditions under which such a machine must operate. It is believed that as time goes on, greater latitude will be given designers, and consequently more will be accomplished, where it is preconceded that the stoker is to be a part of the locomotive.

Fuel Consumption.

Commenting generally upon their report, the committee state, inter alia, that the fuel consumption seems to vary almost in proportion to the physical fineness of the coal used in stoker firing with the scatter-type machines, a percentage of the lighter material being evidently drawn through the tubes by the heavy action of the draft. Using Pocahontas nut stoker-fired, and run-of-mine hand fired, the consumption figures are not far apart. From this it would appear that with the higher volatile coals containing a smaller amount of fine product, the consumption of fuel as between hand-fired and stoker-fired should be very close. It also seems evident that, though the consumption increases as the coal becomes finer in character, the stoker is better able to maintain steam with it than might be secured on an average hand-fired.

With reference to the emission of smoke, it was mentioned in the last year's committee report in substance that, as combustion is improving in stoker firing, as against irregular hand firing, there should be some diminution in smoke. Some observers have reported that with a thin fire and conditions otherwise favorable, stoker firing as with hand firing well executed, little objectionable smoke is emitted, but as the difference in the range of operating conditions and character of fuel are usually so large, a liberal view must be taken of what might be expected. The committee intimated that they had not the opportunity to make extensive investigations, but received reports that when the feeds are not forced beyond the limits of complete combustion, the reduction in smoke is longer maintained with the underfeed than with the scatter types, on account of the fuel being delivered up through the bed of the fire as combustion progresses, when under conditions of service and character of fuel suitable to their present stage of development.

Pulverised Fuel.

Following the presentation of last year's report on this subject, some interesting remarks were made with reference to contemplated experiments with pulverised fuel on locomotives. It is understood that the New York Central has made some investigations in connection with the use of such fuel on switching locomotives, and that the Pennsylvania Railroad has also given it some consideration, but in neither case have they meantime anything of interest to offer.

In the discussion which followed the reading of the report, many instances of the ability of stoker fired engines to handle heavy tonnage under extremely adverse conditions were freely cited.

* * *

A Year's British Boiler Explosions.—The Board of Trade report states that during the year ending June 30 of last year, 66 preliminary inquiries and 14 formal investigations were held into boiler explosions. Of these 80 explosions, 40 resulted in loss of life or personal injury, 31 persons being killed and 42 injured. The 31 deaths were caused by 20 explosions, 11 on land and 9 on ships.

* * *

OILS FOR STEAM TURBINE LUBRICATION.

GENERALLY speaking, the oils most suitable for steam turbine lubrication are pure mineral oils free from acidity and soaps, and incapable of emulsifying when shaken with warm water, and even with a well-designed bearing good results can only be attained when proper mechanical provision has been made for lubricating it efficiently and with a lubricant suitable for its particular purpose. Assuming that facilities are given for the oil to spread over the whole of the bearing surfaces, the best results are obtained by the use of a lubricant that will just keep the moving surfaces apart, under the maximum pressure to be expected, even when the turbine is stationary and at the highest temperature which the bearings may be expected to reach for if the oil has not sufficient body to resist the pressure when the machine is at rest there will be metallic contact between the shaft and the bearings and abrasion will occur on starting, and although the oil "gets round" the bearings after a few revolutions the damage will have been done. The more viscous a lubricant and the stronger the adhesion between it and the bearings, the greater the pressure it will sustain, but a too viscous oil creates unnecessary friction, and power is wasted in overcoming it.

* * *

CHAIN-DRIVING IN TEXTILE MILLS.

THE advantages which might usually be expected to accrue from a substitution of chain-gearing for some other form of transmission in textile factories were:—

(1)—Improvement in quality and product due to uniformity of turning.
(2)—Increase in production.
(3)—Space saved.
(4)—Lower first cost.
(5)—Economy of power.

It is pointed out with regard to increase in production that, with the positive method of driving which chain-gearing gave, no reduction in speed is caused by overloads, the ordinary slip of belts or ropes was eliminated, and in some cases, on account of the improvement in the uniformity of turning, it was possible to speed up the machines.

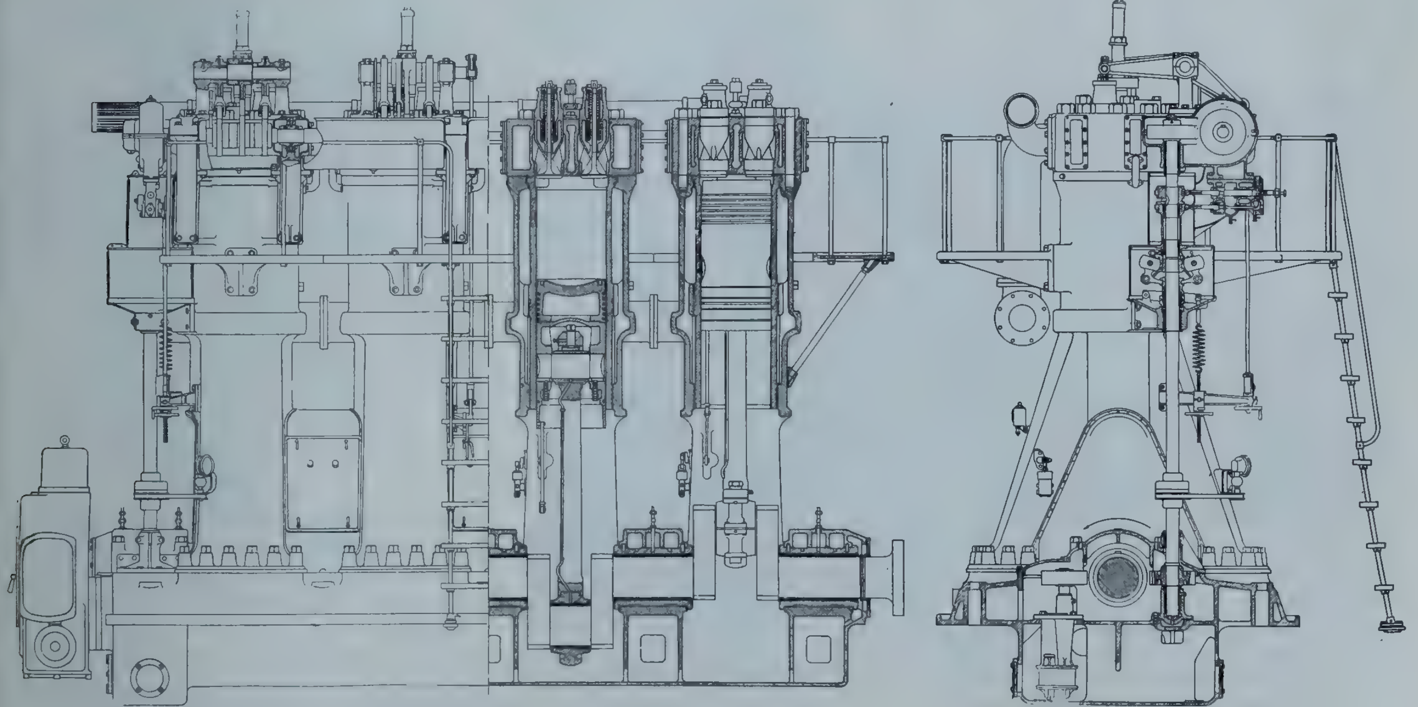
As to economy of power over an extended period of running, at least 5 per cent. has been gained by the substitution of a well-designed chain-drive for any rope or belt drive, and under certain conditions the economy might be much higher.

Internal Combustion Engines

ELECTRIC POWER CO. PLANT, OSHAWA, ONT.

To the Electric Power Co. belongs the distinction of having installed the largest Diesel engine electrical generating unit in Canada at their new power house and sub-station, Oshawa, Ont. The company has, however, generating stations at Trenton, and also at several other places in the Trent Valley, from which the Oshawa and Whitby districts are supplied with power by means of high tension transmission lines. To obviate the inconvenience of a breakdown in the transmission lines, the Diesel engine set was installed as a stand-by, and is arranged so that current can be fed back into the line west of Port Hope in case of necessity.

The power house and sub-station are in one building, divided off. The former is 50 by 52 feet, by 36 feet high, while the latter adjoining is 60 by 35 feet. The building is of fireproof construction, with brick walls, steel sash, concrete floors, and reinforced concrete roof carried on I beam purlins, supported by steel roof trusses. The general contractors were the Midland Construction Co., of Toronto, who sub-let the contract for the building to Wm. Garnet & Sons, Port Hope. The steel was supplied and erected by the Dixon Bridge Co., Campbellford. Provision has been made for the extension of the power house when necessary by making the north wall a temporary structure. The plans call for an 80 feet extension, which will allow room for six generating units. Foundations for one more units have already been laid.



FRONT, SECTIONAL AND END ELEVATIONS OF WILLANS & ROBINSON 615-675 HORSE-POWER DIESEL ENGINE.

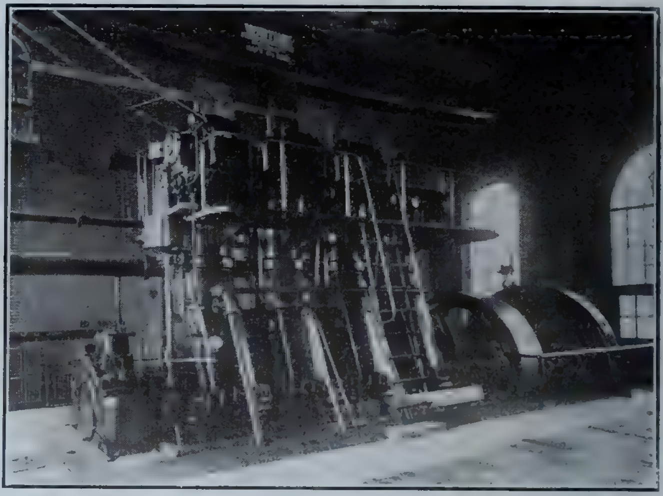
The Diesel Engine.

The Diesel engine was built and installed by Willans & Robinson, Rugby, England. Being a stand-by, the engine has not been run for any length of time, except in connection with the exhaustive tests which have proved its suitability for the work. One very important feature is that the engine can be brought from rest up to full speed with full load in less than two minutes. No boilers are, of course, required, therefore, no stand-by losses from that source affect the economy of operation.

The engine is of the inverted 4-cylinder type, and is capable of developing 615 h.p. when running continuously at the normal speed of 180 r.p.m. It will develop 675 h.p. for a few hours when required. The cylinders are single acting, and work on the 4-stroke cycle principle. The cylinder wall is of tubular construction, pressed into the single casting which forms the frame and water jacket casing. The cylinder liner and head are held in position in the frame by studs. The valves are opened and closed by cams and springs respectively. The exhaust valve levers are in two parts to facilitate the examination of the valves, while the fuel valves are accessible without removing the levers which open them. None of the valves are water cooled, but the jackets of the exhaust valve casings extend round the valve spindle guides.

The engine is equipped with a forced lubrication system, oil being pumped from a tank on the engine, and fed by a centrifugal pump driven by bevel gears on the main shaft near the compressor. The oil is forced through the main bearings, through the drilled crank shaft, and from the crank end to the piston end of the connecting rod by pipe. The pistons are oil cooled, cooling chambers being provided, through which oil is forced by the pump just referred to. The oil is delivered through a filter on top of the tubular oil coolers on base of engine, then through the coolers to the distribution pipes and bearings, and back to tank on engine bed. A relief valve is placed in the delivery pipe and is adjusted to a pressure of 15 lbs.

REAR VIEW OF COMPLETE UNIT.

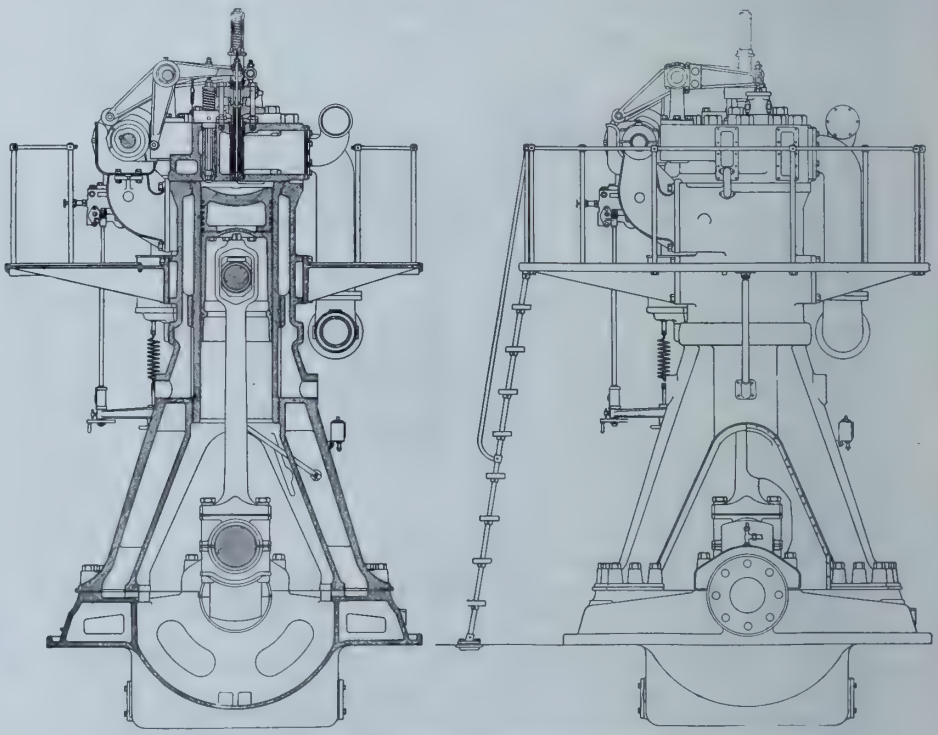

FRONT VIEW OF COMPLETE UNIT.

The fuel pump discharges into a common distribution box fitted with an outlet valve to each cylinder and adjustable by hand. The governor, which is mounted on a vertical shaft, controls the speed of the engine by timing the closing of the fuel pump suction valve, so that the actual quantity of fuel delivered to the cylinders is sufficient for the load. The fuel oil flows to the engine from two 400-gallon tanks placed overhead in the engine-room. The oil is pumped to these tanks from a storage tank situated in the yard by a rotary pump driven by a 2 h.p. Century motor. The storage tank has a capacity of 10,000 gallons, and was supplied by the John Inglis & Co., of Toronto. It is located near the tracks of the Oshawa Electric Railway, and is filled direct from tank cars by a 2-in. Goulds centrifugal pump driven by a 3 h.p. Canadian Westinghouse motor, 220 volts, 3-phase.

Compressed Air Equipment.

The compressed air equipment of a Diesel engine is one of the most important features in its operation, as the use of crude oil in this type of engine depends entirely on air at high pressure being available for spraying the crude oil into the cylinders. The air pressure ranges from 540 to 1,000 pounds per sq. in., and a constant and steady supply is always available. This is arranged for by the use of storage bottles or receivers working in conjunction with the compressor. Reavell & Co., Ipswich, England, built the compressor, which is of the three-stage quadruple type. It is driven by an overhung crank, bolted to a flange coupling on the end of the main crank shaft. The compressor has two low pressure cylinders of 12 ins. diameter, one intermediate cylinder of 8 ins. diameter, and one high pressure cylinder of 4 ins. diameter. The stroke for all is 7 inches.

Air is delivered to three receivers located near the engine; the receivers being for starting, running and reserve starting respectively. The starting receivers are piped to the starting valves on two of the engine cylinders, while the other two cylinders automatically come into normal operation as soon as the speed is sufficient to give the necessary compression temperature to ignite the fuel oil. One or more receivers are always kept charged, but if by any mischance the air should be lost, a hand operated compressor has been installed to supply the deficiency.


END ELEVATIONS OF 615-675 HORSE-POWER DIESEL ENGINE.

Water Cooling Apparatus.

The water cooling apparatus for the cylinder water jackets is located outside the engine-room. It consists of a reinforced concrete tank, 40 by 20 by 5 feet, with partition walls projecting 4 feet over the tank and supporting the cooling structure. The structure consists of a series of boards arranged in the form of steps, and surmounted by a distributor, to which water is pumped through a 4-in. pipe from the engine. A 4-in. suction pipe connects the tank to engine base, where it is reduced to 3 ins. for the pump connection. The 3-in. rotary pump for the cooling water system was made by the Drum Engineering Co., Bradford, England. It is belt driven from the periphery of the coupling on the engine crank shaft. In addition to the cylinder jackets, the exhaust pipes and valves, the oil coolers and compressor coils are all cooled by this system, which enables the same water to be used continuously with little wastage. In very cold weather the cooling structure is not used, the water going direct to the tank by means of a by-pass.

An 8½-ton capacity hand operated overhead traveling crane is installed in the engine-room; this was supplied by the Whiting Foundry and Equipment Co., of Harvey, Ill. The engine-room is illuminated by 15 100-volt tungsten lamps suspended from the ceiling in conduit drops.

Generator

The engine is direct connected to a 500 k.v.a. 4,160-volt, 3-phase, 60-cycle generator mounted on an extended bedplate. The machine is excited by an 11 k.w. 115-volt exciter, direct connected to generator shaft. The generator is wound for 4,160 volts, and a connection brought out from the neutral enables a 2,400-volt circuit to be obtained. A tunnel has been constructed to take the leads from the generator to the sub-station. The generator and exciter were made and supplied by the Swedish General Electric Co., through their Toronto office. Tests made after installation proved that the machine was well within guarantee.

Switchboards.

The switchboards are located in the sub-station adjoining the engine-room. One of these, of Canadian Westinghouse make, is for the generator, and consists of two panels, generator panel, and totalizing meter panel, upon which are mounted voltmeters, ammeters, C.G.E. graphic wattmeter, and Canadian Westinghouse integrating wattmeter. The main switchboard, also Canadian Westinghouse make, consists of ten panels, upon which are mounted the necessary instruments and circuit breakers, graphic and integrating wattmeters, and a graphic voltmeter, etc. The town lighting board, of C.G.E. make, has three panels, equipped also with the necessary instruments.

Transformers.

The transformer room is in the sub-station, and contains two 750 k.v.a. Canadian General Electric Co. transformers, with provision left for additional units. The current is stepped down from 44,000 to 4,160 volts, the current being 3-phase, 60 cycles. The transformers are cooled by water from a cooling tower of tray type, circulated by a twin volute pump direct connected to a 3 h.p. motor, 220-volt, 3-phase. For changing the oil, two 2,000-gallon capacity oil tanks are installed under the transformers. A rotary hand pump is used for pumping the oil back to the transformers in the event of their having to be emptied. On the floor, in front of the transformers,and lower level is a track upon which runs a trolley to facilitate the removal of the transformers when required. At the end of the transformer room is installed a 15-ton capacity Yale & Towne hand operated hoist, also for handling the transformers. A Gurney boiler is installed in the basement of sub-station for heating the building by steam, the mains being placed in a terminal under the engine room, together with auxiliary water piping and cables from generator to switchboard.

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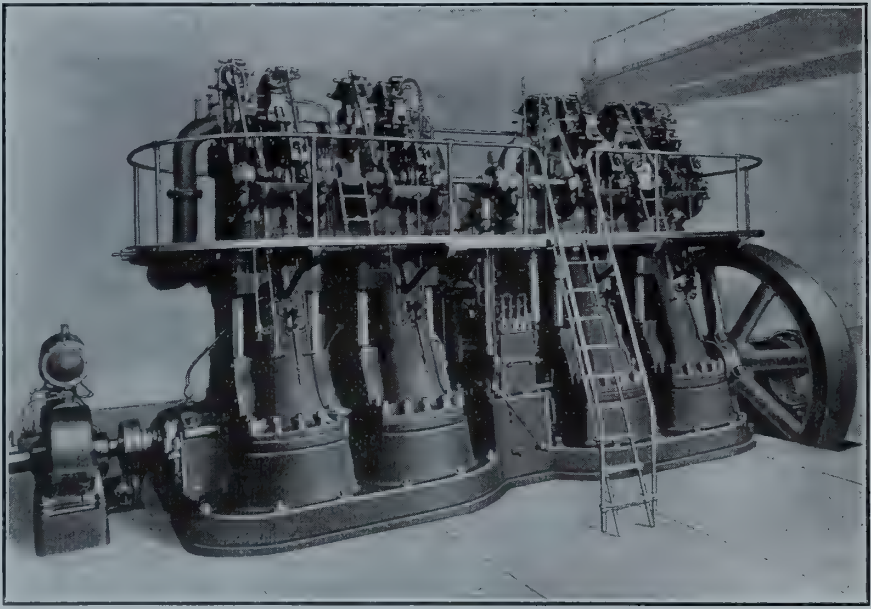
LARGEST AMERICAN-BUILT DIESEL ENGINE.

THE largest Diesel engine constructed to date in America, and the first piece of heavy machinery of this type taken through the Panama Canal, has come recently from the plant of the Lyons Atlas Co., Indianapolis, Indiana.

The engine is of the vertical, four-cycle type, with four cylinders, each of 21 in. bore by 30 in. stroke, and capable of developing 690 brake horse power. It has been sold to the Hawaiian Commercial & Sugar Co. through their New York agents, Alexander & Baldwin, Ltd., 82 Wall street, and is intended to supersede one of their steam plants for irrigation purposes in the Hawaiian Islands, where it will be direct connected to a two-stage turbine pump of 15 million gallons capacity. The conditions covering the acceptance of the engine were severe. The purchaser insisted that the engine should operate continuously 700 hours out of each 720 hours per month at rated load, using the ordinary 14° to 18° asphaltum base California fuel oil, similar to that used in the purchaser's steam plant, and which is the only grade available on the Islands.



LYONS ATLAS CO. LARGEST AMERICAN BUILT DIESEL ENGINE.

Test Data.

The test was conducted by the chief engineer of the Hawaiian Commercial & Sugar Co., and the engine was given a preliminary continuous run of 48 hours with Eastern paraffin base fuel, after which all parts connected with the combustion chambers were inspected in order to determine a basis for comparison between the effect of the two fuels. It was then subjected to a 144-hour continuous run at full load with fuel shipped by the purchaser from California to the manufacturer's works. On completion of this run, the combustion chambers were again examined, and as there was no evidence of deposit on the heads, valves or pistons, the engine was accepted and is now being erected by the purchaser's engineers without assistance from the manufacturer. The actual fuel oil consumption of this engine at any average load between one-half and full rating is a trifle under one-tenth of a gallon per kilowatt hour delivered on the switchboard, or one-fifteenth of a gallon per brake horse power hour. This means that when paying 3 cents per gallon for fuel oil, the fuel cost is less than three-tenths of a cent per kilowatt hour, or a trifle under one-fifth cent per brake horsepower hour. The cost of attendance is considerably less than in a first-class steam plant, because all firing room expense is eliminated, and one engineer, it is claimed, can take care of 1,000 to 1,500 b.h.p. of Diesel engines. Furthermore, there are no stand-by losses, as the engine is available for full load service within one minute at any time, even if started up from a cold stand-still.

In the design of this engine there are no carburetors, magnetos, or other mixing or ignition devices; it is strictly a combustion engine of uniform motion, and does not operate on a series of explosions. The indicator diagram is like to that from a steam engine. Regulation is within 2 per cent. from no-load to full-load and vice versa. The angular variation is a minimum, and the manufacturers guarantee successful parallel operation in direct-connected electrical service, either a.c. or d.c., 25 or 60 cycle.

The engine contains no radical departures, but represents a harmonious combination of the best features of innational Diesel engine practice, without being limited to a reproduction of any single contemporary design.

CYLINDER TEMPERATURES.

IN the construction of internal-combustion engines, the thickness and quality of the material used for cylinders and pistons, and the effects produced by very high temperatures are matters which have to be very seriously considered. It is quite conceivable that a thick cylinder opposed to high temperature as well as to a high pressure inside of it will be actually more stressed than a thinner one. The same reasoning applies to the piston crown and the bottom of the cylinder covers. As was pointed out by J. T. Milton in his paper, the "Present Position of Diesel Engines for Marine Purposes," the metal in these parts is put into a state of compression by the high state of the temperature, the sides being subject to a similar stress due to the pressure. These considerations show the great importance of keeping the thickness of the metal at parts exposed to great heat as thin as possible consistent with their possessing sufficient strength.

It is known that cast iron appreciably changes its form and dimensions through continuous exposure to high temperatures, and so causes troubles similar to those which have occasionally been experienced in large steam engines. It is probably the fear of this action under severe heat conditions which led to the use of cast steel for cylinder covers. Most Diesel engine manufacturers have reverted to the use of cast iron for covers, and some of them give the metal a severe heat treatment before the completion of the machining operations. It is quite possible, however, that cast steel will be again used for these parts.

CRANK CHAMBER EXPLOSIONS.

AMONG the explosions of various kinds that came under an inspector's notice, it is interesting to note the record of oil explosion in the crank chambers of high-speed engines. The inspector for the N.W. district of England reports three explosions of this nature—two in the crank chamber of gas engines, and one in the crank chamber of a steam engine in an electric generating station. Similar explosions have been reported in recent years, with fatal results, all of which occurred in engines of the enclosed type, with superposed cylinders, in which the engine framing is constructed as a hollow chamber to hold the lubricating oil in which the cranks, crank shaft and eccentrics run.

A special oil with a flash point of 400° to 450° F. is generally used, and its constant agitation by the engine cranks not only raises the temperature (records in unventilated chambers show temperatures of 150° to 160° F.), but causes a fine spray or mist of oil to fill the chamber. This mist contains oil particles in such a finely divided state that it requires only a spark or overheated surface to cause ignition.

Explosion Causes.

Explosions in crank chambers of steam engines have been caused by ignition due to defective lubrication and overheating of the slides. In gas engines, ignition may be due either to escape of heated gases round the trunk pistons, or to vaporized oil coming in contact with an overheated piston, or possibly to splashing of oil into the cavity of the trunk piston, where it dries and forms a deposit of carbon, which may become incandescent from an overheated piston, and thus ignite the oil vapour.

Removal of the combustible gases by means of plenum ventilation has proved the solution of the trouble with gas engines, but it is not clear if the same means would equally answer with steam engines, although plenum ventilation would reduce the temperature of the crank chamber. Percentage analyses of gases from the crank chamber of a gas engine, A before and B after plenum ventilation has been installed, are given below:—

ANALYSIS OF GAS ENGINE CRANK GASES.

	CO2	CO	CH4	H	O	Combustible Gases.
A	4.4	10.4	Nil	Nil	11.6	10.4
	0.4	Nil	Nil	Nil	19.6	Nil
B	0.2	Nil	Nil	Nil	19.6	Nil

Temperature of oil in crank chamber (B) 131° F.

Previous to the installation of plenum ventilation at the works from which the above results were obtained, both water cooling and natural ventilation (by connecting up the crank chamber to a mill chimney) had been tried, but neither method nor a combination of the two gave satisfactory results, and, after a further explosion, plenum ventilation was installed.

TURBINE VS. GAS ENGINE FOR STEEL PLANTS.

SPEAKING before the Chicago Section of the American Institute of Electrical Engineers on "Power Problems in Steel Mills," F. G. Gasche made pointed reference to the shortcomings of the gas engine as an exclusive prime mover for steel mill service. Mr. Gasche's remarks were directed particularly to the four-cycle twin tandem type of large capacity, driving alternating-current generators. The unsuitability of this type of prime mover for exclusive use, granting that under steady load conditions the gas engine has enough advantages to warrant its supplying a part of the power required, was based in part upon the following facts:

Steel Mill Loads.

Investigation has not yet given sufficient data for determining accurately the extent of the loads thrown suddenly upon the prime movers in steel mills, particularly motor-driven mills. Supplying sufficient space capacity in gas engine units to carry these peak loads is accordingly a matter of guesswork, and especially so because the regulation of the gas engine of the type under discussion is hopelessly inadequate to the instantaneous character of the mill load variations. The weight that is required to be put into fly-wheel and rotor parts to equalize the load is entirely out of proportion to the effective capacity of the units, and the drag resulting from the inertia of these moving parts makes the question of adequate regulation impossible of satisfactory solution. The variation in torque inherent in the gas engine of this type as a prime mover, even under ideal conditions of constant load, is another essential handicap to its harmonious adaptation. The addition of the storage battery for the absorption of the peak loads, to the gas engine plant at some of the steel plants, does not provide a sufficiently flexible nor economical regulator of the load to offer a solution of the difficulties.

Suggested Arrangement.

Mr. Gasche ventured the suggestion that a design of prime movers for a steel mill might provide 70 per cent. of the capacity in gas engines and 30 per cent. in steam turbines, in which proportion the probability of the power plant adapting itself to the load conditions would be improved in every respect. Against the future development promised in the field of the gas engine, the possibilities to be realized in the use of superheated steam, in the range of temperatures above 700° F., were regarded as even more attractive.

GAS POISONING.

THE following is an extract from a table made up from cases reported as accidents under Section 4 of the British Notice of Accidents Act, 1906, which serves as some guide of the frequency of cases of poisoning by gases:—

Nature of Gas or Fumes. (1)	1913. (2)	1912. (3)
Carbon monoxide	59^{7}	91^{13}
(a) Blast furnace......	20^{3}	33^{5}
(b) Power (suction producer, Mond, Dowson)	21	19^{4}
(c) Coal	9^{4}	29^{2}
(d) Other	9	10^{3}

The small figures relate to fatal cases, and are included in the principal figures.

Blast Furnace Gas.—Among the 20 cases with three deaths reported from blast furnace gas, eight occurred in charging at the cupola, eight from cleaning operations, mainly of flues, and three in repair work. One of the fatal cases occurred to a tar still man in an iron and chemical works who, towards the end of a double 12 hours' shift, retired to lie down on a bench in a small shelter fitted with a door and heated by means of the furnace gas supplied by a 1 in. pipe. When his father came to relieve him the man was found unconscious. The gas was turned on, but was out either as the result of fluctuation in the pressure or of the deceased's foot touching the tap. The door of the shelter was closed.

Power Gas.—Of the 21 cases, one occurred in starting the plant, two in stoking, twelve in cleaning or repairing, and six by escape of gas from a leak in the purifier. In one case the workman, knowing the danger, entered the scrubber through a manhole. In another, the workman chose to lie down to rest beside the engine.

GRAPHITE LUBRICATION.

THE employment of graphite as a lubricating medium for machinery is a matter which has often been discussed among engineers. The mixing of graphite with oil, a system tried for engine lubrication and other purposes, has not always been attended with such satisfactory results as are to be desired, but there can be no doubt that, properly applied, graphite ranks among the most efficient of all lubricants. Countless experiments have been made to unite the substance with various metals in a molten state, but without success, and another system of application has consisted of graphite plugs inserted in bearing surfaces, but here the cost of drilling the holes for each separate plug and putting each individual one in its place has made the process too expensive for ordinary purposes.

In view of these circumstances it is with interest that we turn to examine a new method of utilizing graphite as a lubricant for white-metal bearings, particulars of which have been communicated to us by the vendors. This is known as the Randall graphite sheet lubricator and consists of a simple device in which solidified graphite cones of a slightly tapered formation are attached by hydraulic pressure to a fine copper-wire screen or fabric which may be cut to the shape and fitted with a minimum of trouble in any white-metal bearing in which it is intended to be used. A piece is cut from the sheet the full length of the bearing, wide enough to reach not quite to the top of the half bearing, and it is important when fitting to so cut the sheet that the plugs or cones have the straight rows running lengthwise, so that the cones are staggered in the path of the rotating journal, and each part of the shaft in the bearing as it revolves will then be in contact with some of the graphite cones.

After cutting, the Randall graphite sheet lubricator can be shaped with the fingers to a half circle a little smaller than the journal, around which, or around a mandril usually employed for the purpose, it is fixed by means of fine copper wire, wound spirally. The small or tapered ends of the cones should always be placed in contact with the journal, so that the wire cloth will be embedded near the bottom of the box. The mandril, with the graphite sheet lubricator attached as described, is placed in the box and the white metal poured in the usual way. The bearing box, mandril and sheet should all be warm so as not to chill the white metal too quickly. The metal will flow and set around the graphite cones, making them a part of the bearing. The result is practically a self-lubricating bearing which requires only a few drops of oil at long intervals.

To finish the bearings, the sides may either be scraped so that the journal will turn freely, or turned in a lathe, which ever is the general practice. In oiling, it is advisable to cut down from 75 to 90 per cent. of the quantity ordinarily used on regular white-metal bearings. Too much oil has a tendency to wash out loose particles of graphite.

In considering the first cost of the Randall graphite sheet lubricator, it should be noted that in many cases it displaces sufficient white metal to pay for itself, and is claimed to increase the life of bearings three to four times. Results have shown that this lubricating device enables white-metal bearings to withstand heavy pressures and high speeds without heating.

GAS ENGINE GAS CONSUMPTION

AS an average figure, it may be stated, says a writer in The Power User, that a gas engine is capable of efficiently utilizing about 25 per cent. of the fuel supplied to it—that is to say, for every 10,000 heat units contained in the gas, 1 b.h.-p. will be available for transmission from the pulley or flywheel for the space of one hour; 1 h.-p. being the equivalent of 2,545 B.t.u. of heat consumed per hour. With town gas of the value of 500 B.t.u. per cubic foot, therefore, 20 cu. ft. will be required for every brake horse-power developed for one hour. With producer gas of 130 B.t.u. per cubic foot, the hourly consumption would be about 77 cu. ft., and so on for other gases, according to their caloric value.

Statements of gas engine performances based on the output of brake horse-power only hold good for engines working at a uniform load approaching the maximum, and consequently, when the mechanical efficiency is the greatest and therefore, according to the increasing proportion of frictional horse-power with lower outputs, so the rate of consumption (but not the actual consumption) at the lower loads will be correspondingly higher.

Statements as to gas consumption per i.h.p., however, are not affected by the mechanical efficiency in the same manner. Modern gas engines can develop 1 i.h.p. for one hour at a thermal efficiency of 30 per cent., being practically the equivalent of 25 per cent. on the brake horse-power basis—and this figure is practically constant for all but the lightest loads, when the relatively cool internal temperatures and slower combustion reduces the thermal efficiency. Thus it may be said that with town gas of 500 B.t.u. per cu. ft. 1 i.h.p. will require 17 cu. ft. per hour; and with producer gas 65 cu. ft., and so on.

To gain an idea of the possible variation of the increased rate of consumption on the brake horse-power basis, on reduced loads from the above figures relating to town gas let it be assumed that the frictional horse-power is constant between full load and half load, then an engine requiring 20 cu. ft. per brake horse-power hour at full load will need 24.3 cu. ft. per brake horse-power hour at half load, or an increase of slightly over 20 per cent. in the rate of consumption. All the same, the rate of consumption on the indicated horse-power basis would be constant, the difference on the brake horse-power basis being merely that due to the proportionately higher frictional losses.

* * *

Keith's, Ltd., Toronto, will supply all the refrigerating equipment for the new artificial ice plant of the Montreal Arena.

Electricity and Hydraulics

THE AUTO-SYCHRONOUS MOTOR.

By C. T. R.

THE importance of obtaining a high power factor for electric power transmission systems is being realized more and more by the managers of power companies, and this is accounted for by the fact that so many water power sites within easy reach of industrial activity have been developed to their full capacity as far as the prime movers are concerned. There is only one possible method remaining of obtaining a greater output from these plants, that is, to raise the power factor on the various circuits of the system and in this way reduce the amount of power wasted in the various electrical apparatus. This result is usually accomplished by means of synchronous motors connected at different points in the distributing system, the power factor being raised by overexciting the fields of the motors.

The Synchronous Motor.

The synchronous motor, however, has great disadvantages and cannot be used with good results in some cases; for instance, it is not suitable for starting up under heavy loads on account of the very heavy starting current required to obtain full load starting torque, another serious objection being that, should the voltage drop suddenly due to a temporary short circuit or other disturbance on the line, the motor will drop out of synchronism and drop dead, and considerable time will be wasted in starting the machine up again. There is also the great disadvantage that, should the source of excitement fail, the motor is rendered useless until it is again restored.

Slip Ring Induction Motor.

The use of the slip-ring type induction motor overcomes all of the troubles mentioned above, but at the same time does not possess the great advantage of the synchronous motor, namely, constant speed at all loads provided the frequency is kept constant, and the possibility of power factor correction by means of over exciting the field.

Auto-Synchronous Motor Features.

In order to combine the advantages of the synchronous and induction type motors and eliminate their disadvantages, the auto-sychnronous motor was designed in 1902 by E. Danielson, a member of the staff of the Swedish General Electric Co., Vesteras, Sweden, who now hold the patents for it. The machine is very similar in design to the ordinary slip-ring type induction motor, the chief difference being in the design of the rotor, in which the cross sectional area of the copper in one phase of the winding is equal to the combined area of the copper in the other two phases. When the machine is operating as a synchronous motor, the two phases of small area are connected in parallel by means of a three-pole, double-throw switch. A diagram of connections is shown in Fig. 2.

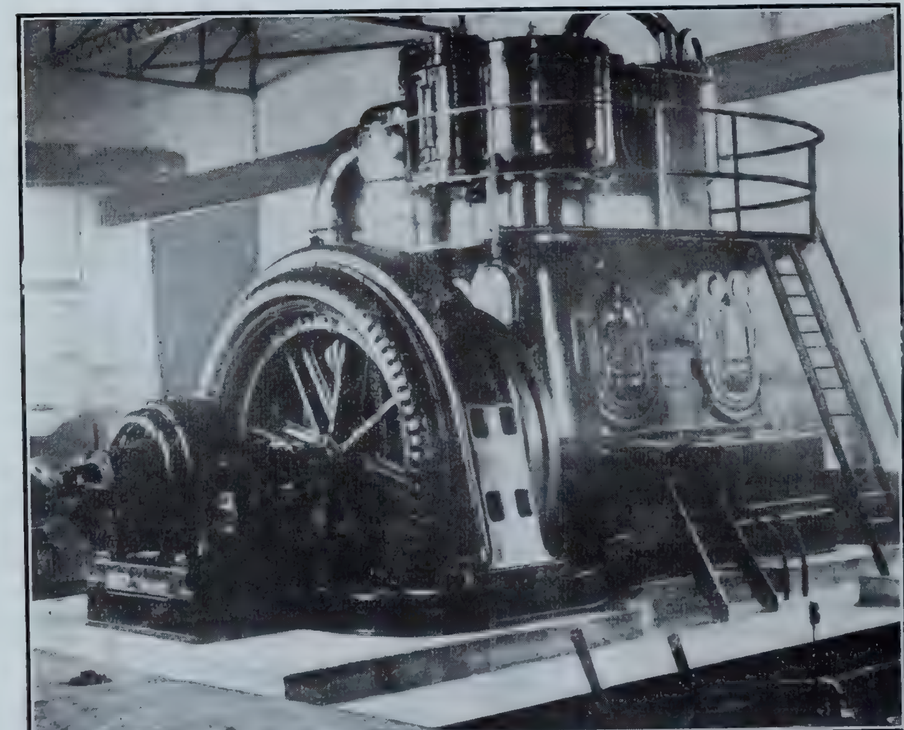


FIG. 1. AUTO-SYNCHRONOUS MOTOR, 940 K.V.A., 2200-VOLT, 25-CYCLE, 187½ R.P.M., DIRECT CONNECTED TO BELLIS & MORCOM AIR COMPRESSOR.

There is usually a special direct connected exciter supplied of the series-wound type. The voltage varies from 16 to 40 volts according to the design of the machine. On account of the low voltage of the exciter, it is almost impossible to have a breakdown, and if one should occur, the machine can still be run as explained later.

Method of Operation.

The method of operation is as follows: The motor is started in a similar manner to an ordinary slip-ring type induction motor, that is to say, by connecting a resistance unit across the slip-rings and gradually cutting out sections until the motor has reachesd its maximum speed, when the slip-rings will be short circuited. The exciter is then connected to the slip-rings by means of a double-throw switch, the starter at the same instant being disconnected, and the voltage on the exciter being brought up to normal. The motor will then synchronize itself automatically and operate with the same characteristics as the ordinary synchronous motor, while the amount of power factor correction required can be obtained simply by varying the voltage on the exciter.

Should a heavy overload now be suddenly thrown on the motor, or the voltage suddenly drop due to a short circuit or other disturbance on the line, the motor will not stop as would be the case with the synchronous motor, but will drop out of synchronism and run as an induction motor until the line or load have resumed their normal conditions. The motor will then automatically drop back into synchronism and run as before the trouble occurred. If now the exciter becomes damaged through any cause, the machine can be run continuously as an induction motor and will carry its usual load.

The auto-synchronous motor is particularly adapted for conditions where synchronous characteristics and heavy starting torque are required. They can be used to great advantage for driving paper mill machinery, air compressors, pumps and all other classes of heavy work.

Fig. 1 shows a 940 kva. 2200 volt, 3 phase 25 cycle, 187½ r.p.m. motor of this type, direct connected to a Belliss & Morcom air compressor. This unit is in operation at the plant of the Canadian Copper Company, at Frood Mine, Ont., and is giving entire satisfaction. A large number of machines of this type are operating successfully throughout the Dominion, these varying from 100 to 1500 h.p. in output.

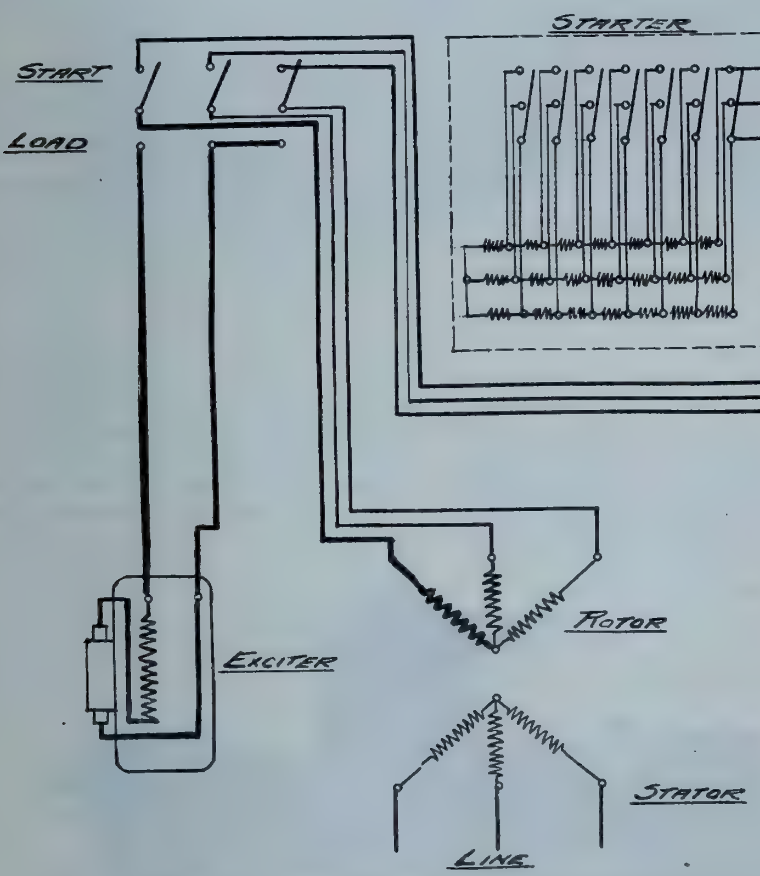


FIG. 2. DIAGRAM OF CONNECTIONS FOR AUTO-SYNCHRONOUS MOTOR.

The writer is indebted to the Swedish General Electric Co., Toronto, for the illustrations accompanying this article.

HYDRO-ELECTRIC VS. STEAM.

IN an address before a recent session of the American Society of Heating and Ventilating Engineers, comparing hydro-electric generation of electric current with generation by steam, Reginald Pelham Bolton gave some interesting statistics as to how the advance in generating methods has assisted in conserving the fuel supply. Mr. Bolton took the stand that electric current may be more cheaply generated on the average by steam than by water, and said:—"The amount of fuel used for the production of a kilowatt of energy in modern plants has been undergoing a continuous reduction, as a result of the greater concentration of the production and the resulting use of better proportioned machinery.

The actual conservation which has been effected by the more economic use of fuel in electric power production far exceeds any results that could have been attained by the use of all the water power in present service. In one of our largest cities during the ten years from 1903 to 1912 inclusive, a total of 3,782,000,000 kilowatt hours was generated by the consumption of 6,284,000 tons of coal. In the year 1903 the rate of fuel consumption per kilowatt hour generated was 6.87 pounds. At the end of ten years this rate has been reduced partly by improvements and partly by the larger units operated, as well as by the improved load factor resulting from combining the demands of more consumers, to less than three pounds of coal per kilowatt hour.

The consumption of coal during the ten-year period, if it had been maintained at the rate prevailing in 1903, would have involved the consumption of 13,000,000 tons of coal. There was saved or conserved, by the process of improvement, more than fifty per cent. The use of very large boilers, used at a high rate of output, combined with large generators, has reduced the coal consumption per kilowatt of energy per hour to less than two pounds weight of bituminous coal, as in the Central Station of the Detroit Edison Co.

Our present demand for coal for all purposes is about 575,000,000 tons per annum. The commercial value of the material is mainly composed of the cost of labor and machinery for its extraction and the cost of transportation from its source to its point of usage. Our entire system of railroads and our vast advantages in water transporation are contributory to the economical distribution of coal, and in low cost of output we take the lead in the world with a production of 600 tons per annum per employee, as against 275 tons per annum per employee in the United Kingdom."

GERMAN ELECTRICAL ACCESSORIES.

WITH that extraordinary persistence which is characteristic of the Teuton, the production of vast quantities of lampholders, ceiling roses, tumbler switches and wall plugs, not to mention bell pushes, bells and small telephones, has continued for many years in the hands of German firms, states the Ironmonger. The British manufacturer has, almost without exception, despised this class of competition, and until recent years made no attempt to meet it. Unlike many other German products, electrical accessories have been both cheap and nasty, and this fact probably explains the reluctance of English makers to enter the market.

The wireman and electrical contractor, on the other hand, have, under pressure from the jerry-builder and keen intercompetition, encouraged the trade in cheap accessories, unpatriotically giving the business to foreign concerns. When present stocks are exhausted the supply of such accessories will, for a time, cease. There is little or no competition from the United States, except in special lines; and it will be instructive to observe what steps the erstwhile lax British manufacturer will take to seize his present opportunity to increase his production facilities. Should he do so, it will be the duty of the trade to support him.

Steam Turbine Driven Centrifugal Pump Efficiencies

By G. H. Gibson

In this article there is pointed out that notwithstanding the ideal arrangement as far as compactness of the direct-connected combination unit is concerned, there falls to be considered, and that primarily, the question of most suitable individual speed operation in order that each may give the most efficient service. A well designed gear-drive is shown to satisfactorily meet every requirement.

IN steam power plants, many opportunities for using turbine-driven centrifugal pumps are found where the turbines can be employed in such a way that large steam consumption is not a disadvantage. Steam turbines driving circulating pumps, boiler feed pumps, etc., may be arranged to exhaust into feed water heaters so that all the heat of the exhaust steam is conserved. Again the pump may be required for short intervals only, as in the case of fire pumps, ash ejector pumps, etc., and a high steam consumption not being objectionable. For such service a direct connected turbine and pump may be used advantageously, particularly when the conditions require small quantities of water at high speeds, permitting of high pump speeds with good efficiency of both pump and turbine. On the other hand, there are services encountered in steam power plants, in which the speed requirements of the steam turbine and of the pump are so far apart that direct connection is inadvisable. For example, in handling circulating water for condensers, when very large volumes of water such as 10,000 to 40,000 gallons per minute have to be pumped against heads of only 20 to 40 feet.

A centrifugal pump driven by a steam turbine is an ideal arrangement. However, due to the high spouting velocity of the steam, the steam turbine should operate at a much higher speed than is suitable for general centrifugal pump work. The problem is therefore one of decreasing the speed of the steam turbine, or increasing the speed of the pump until the two coincide.

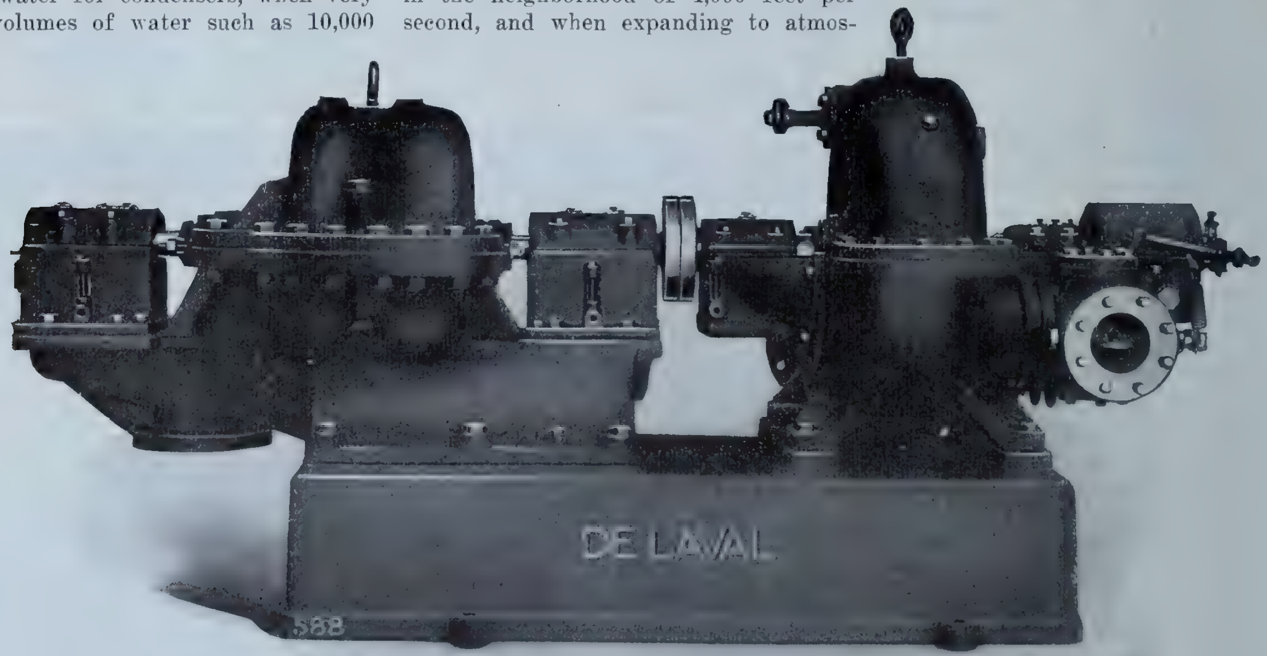
The simplest form of turbine-driven pump would be a single-stage turbine driving a single-stage pump. This, however, with ordinary steam pressure, would imply pump heads far exceeding those required in practice, as will appear from the following:—

The heads developed by centrifugal pumps of commercial design do not vary widely from $\frac{V^2}{2g}$ where V is the peripheral velocity of the impeller in feet per second, and (g) is the acceleration of gravity, or 32.16 feet per second. The spouting velocity of steam expanded from boiler pressure to a high vacuum is in the neighborhood of 4,000 feet per second, and when expanding to atmosphere, a little less than 3,000 feet per second. In a reaction turbine, the buckets move, for the best efficiency at the velocity of the steam and in an impulse turbine at half of the velocity of the steam. If the pump impeller were of the same diameter as the wheel of an impulse turbine, the head generated would be 35,000 feet for 1,500 feet per second bucket speed, which is approximately the velocity of the buckets in commercial single-stage turbines.

Turbine Speed Reduction.

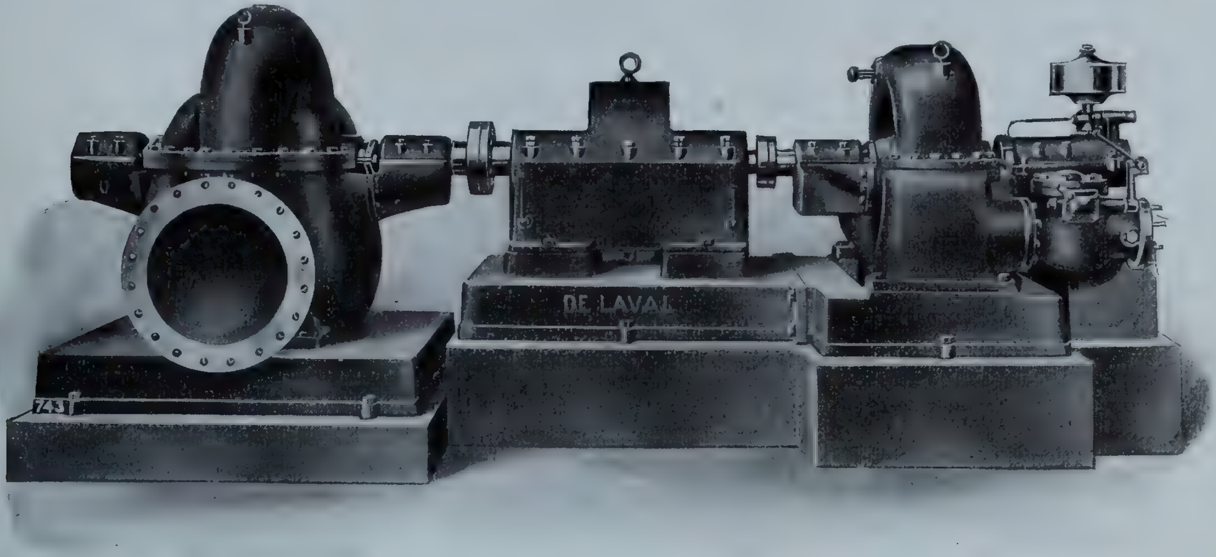
These figures bring out vividly the necessity of some means of speed reduction between the steam turbine and the pump. The simplest method is to make the diameter of the pump impeller less than that of the turbine wheel. If the turbine wheel, for instance, is 3 feet in diameter and the pump wheel is 8 inches in diameter, the peripheral velocities will be in the same ratio, i.e., with a peripheral speed of the turbine wheel of 1,500 feet per second, the periphery of the pump impeller would run at 334 feet per second, and the head generated would be some 1,730 feet.

This is still a much higher head than is commonly required or than is suitable to a single-stage pump and it is obviously necessary to reduce the turbine bucket velocity, or to incorporate some mechanical speed reduction between the turbine



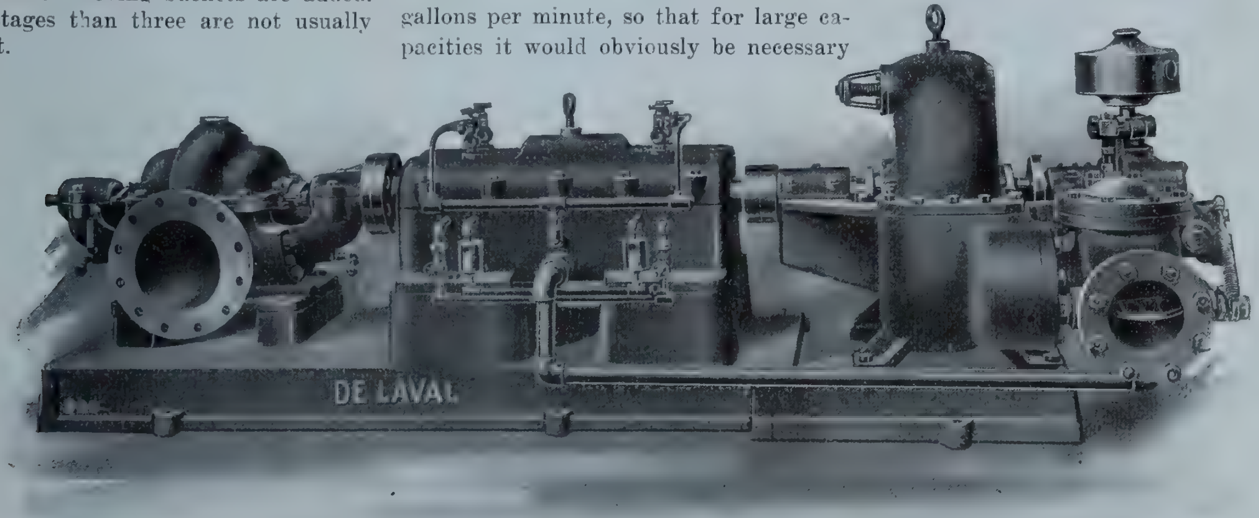
TWO-STAGE BOILER FEED PUMP DRIVEN BY A VELOCITY-STAGE TURBINE.

and the pump. Aside from having the turbine wheel run at some speed slower than the theoretically most efficient speed, there are two methods of reducing turbine speeds, viz., velocity-staging and pressure staging.



24-INCH SINGLE-STAGE PUMP DRIVEN BY 350 HORSE-POWER VELOCITY-STAGE GEARED TURBINE.

Velocity staging is exemplified by having the steam expanded completely from initial pressure to exhaust pressure in a single set of nozzles and having it impinge upon a first row of moving buckets from which it is deflected to a row of stationary guide vanes and again directed upon a second row of moving buckets. In some cases a second row of stationary guide vanes and a third row of moving buckets are added. More stages than three are not usually efficient.



CIRCULATING PUMP FOR MODERAT-SIZE CONDENSING EQUIPMENT, DRIVEN THROUGH SPEED-REDUCING GEAR BY A VELOCITY-STAGE TURBINE.

With velocity-staging, the buckets for best efficiency should move at a velocity equal to the velocity of the steam divided by twice the number of velocity stages. About the highest permissible bucket speed for a turbine of this type is 600 feet per second, which theoretically with three velocity stages will utilize the steam efficiently when expanded from boiler pressure to vacuum. A bucket speed of 600 feet with a 3-foot turbine wheel and an 8-inch pump impeller directly connected would give a head of approximately 275 feet.

To develop a head of 40 feet, which is quite common, a peripheral velocity of the impeller of 51 feet per second is necessary, which, with an 8-inch impeller, would imply a speed of only 1,450 r.p.m. The capacity of an impeller of this size, however, would not be over 1,500 gallons per minute, so that for large capacities it would obviously be necessary to employ still slower pump speeds. That of 1,450 r.p.m., however, is already far too slow a speed for good economy for a commercial turbine of the corresponding capacity.

Pressure Stage Speed Reduction.

Most users of centrifugal pumps require a reduction in speed more radical than can be secured, with efficiency, by the method of velocity staging. The pressure stage method permits of a still further speed reduction. This consists of a number of impulse wheels, each operating in a separate chamber, and receiving steam from a separate set of nozzles. All of the wheels are mounted on a common shaft, and the pressure drop from the inlet pressure to the exhaust pressure is divided into as many steps as there are wheels. Inasmuch as the velocity of the steam varies approximately as the square root of the pressure drop, in order to halve the bucket speed, and likewise the speed of revolution, four times as many stages are necessary, and for one-quarter speed sixteen times as many stages.

It is readily apparent that pressure staging is also inadequate where the highest efficiency is required, and the use of some mechanical means of speed reduction is the only successful method of combining the highest turbine efficiency with the highest pump efficiency for most pumping conditions.

In connection with this question of the proper speeds of centrifugal pumps it should be borne in mind that it is impossible to obtain good efficiency with a pump running too fast for the head generated, or in other words, a pump developing a shut-off pressure cannot be efficient. There is a certain definite relation of shut-off pressure to working head that gives the best efficiency, and this relation must be adhered to within rather close limits.

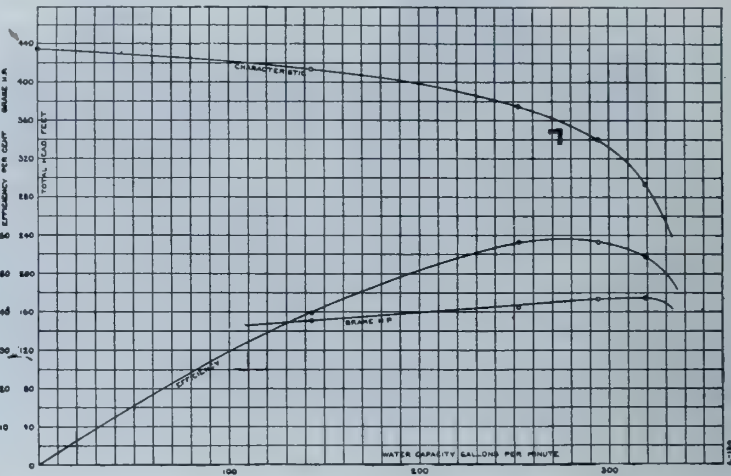
The size of an impeller inlet is determined by its capacity, and its outside diameter is determined by the head in connection with the speed. An impeller, to give the maximum efficiency, should have its inlet and outside diameters properly proportioned, or in other words, the size of the inlet opening (capacity) should bear the proper relation to the outside diameter (head and speed).

Another consideration in attempting to run pumps at speeds differing from the correct speed for the head and capacity is the mechanical operation. This is equally as important as the efficiency. Pumps are frequently operated at speeds very much higher than is desirable, in order to adapt them for direct connection to high speed motors and steam turbines, resulting in incorrect hydraulic design and poor mechanical construction. First of all, when the pump is operated at a speed higher than is consistent with the conditions, cavitation may be produced, resulting in corrosion of the metal of the impeller. Vibration also may produce corrosion of the impeller, due to the water being unable to follow the rapidly vibrating surfaces, thus causing another form of cavitation. Furthermore, vibration tends to destroy the bearings, and in some cases will crystalize the shaft, causing it to break, usually on the dead end or end through which no driving torque is being transmitted.

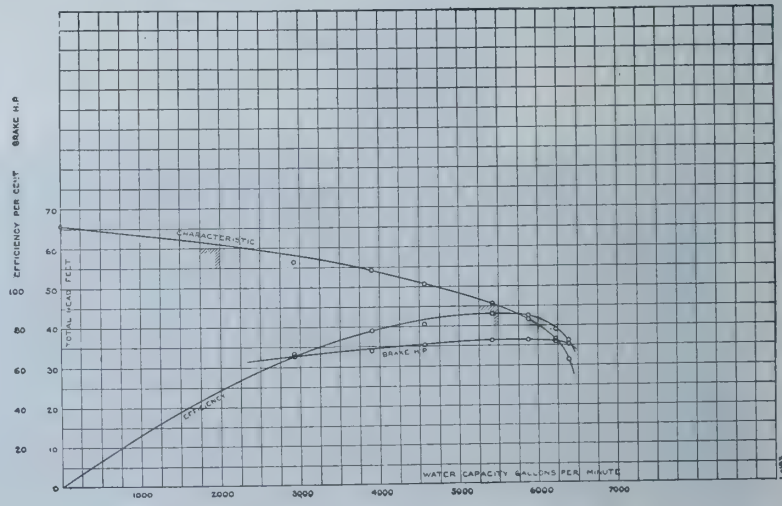
The so-called multi-impeller or bi- and tri-rotor pump is the result of an attempt to accommodate high speed to heads that would not be consistent with such speeds for a single impeller pump. This type of pump consists of a single casing in which are placed two or more impellers mounted on one shaft and operating in parallel, that is, all drawing from a common suction chamber or pipe and delivering to a common discharge chamber.

Multi-Rotor Pumps.

The multi-rotor pump has many hydraulic and mechanical shortcomings. First, it implies a long shaft heavily loaded with a series of impellers, and thus there is every tendency toward vibration, with the resulting bad effect on bearings, shaft and impellers, to say nothing of the damage to wearing rings and tightening parts. As a rule, multi-impeller pump shafts are not properly designed as to critical speed, which results in vibration. If the shaft is made as heavy as it should be for safety, the impellers and such parts become cumbersome and the whole machine expensive. As a result, the shafts are made too light for centrifugal pump work, where exact balance of the rotating parts cannot be insured after the pump has been in operation for long periods.



TEST CHARACTERISTICS OF DELAVAL TWO-STAGE 4-INCH BOILER FEED PUMP, 275 GALLONS PER MINUTE, 350 FT. HEAD, 3,000 R.P.M.



TEST CHARACTERISTICS OF DELAVAL 16-INCH SINGLE-STAGE CIRCULATING PUMPS FOR BAROMETRIC CONDENSER, 5,500 GALLONS PER MINUTE, 45 FT. HEAD, OR 2,000 GALLONS PER MINUTE AT 60 FT. HEAD, BOTH AT 860 R.P.M.

Multi-Impeller Pumps.

The multi-impeller pump contains many more wearing parts and parts subject to deterioration than does a single impeller pump. In the case of a tri-rotor pump, for instance, there are practically three times the number of parts, and the cost of maintenance will be proportionately high, even neglecting the tendency toward vibration and generally poor mechanical construction. The leakage areas, friction loss in impellers and other such losses are greater in the multi-impeller pump and it can easily be seen that a pump of this type under the best conditions could not give an efficiency higher than a single impeller pump of one-third the size and capacity. In actual practice, the multi-impeller pump gives less efficiency than a smaller size single impeller pump.

Many multi-impeller pumps are extremely inaccessible and in all of them the replacing of impeller wearing rings and such parts can only be done after removing all the impellers from the shaft, which, with some of the common types of construction, is a difficult operation. It is also impossible in a pump of this kind to make all of the water passages of equal area, equal length and symmetrical, with the result that very often one impeller or one side of an impeller will do more work than the other resulting in low capacity, poor efficiency and axial thrust. This action is very similar to that often encountered when a number of centrifugal pumps are attached to a common suction line. The disadvantages of the multi-impeller pump may be summed up briefly as follows:

Poor efficiency and short life or inability to maintain efficiency over long periods; tendency to vibration with its resulting destruction of impellers, bearings, shafts, wearing rings, and such parts; general inaccessibility; uncertainty of operation or lack of stability, including loss of capacity through slight disturbances which would not affect a single-impeller pump; multiplicity of parts subject to wear and resulting high cost of maintenance.

Screw or Propeller Pumps.

Screw or propeller pumps have also been used in order to accommodate high turbine speeds, but this type of pump has invariably proved unsatisfactory, first of all on account of the low efficiency, and second, due to the difficulties of cavitation, corrosion and vibration that are practically always present in a pump of its type when operating at high speeds. Low speed screw pumps for low head work have operated satisfactorily, but usually the efficiency, even with the low speeds, is poor.

Summing up the question of turbine and pump speeds, it is apparent that the most satisfactory form of speed compromise is one that will permit the two members of the pumping unit, namely, the steam turbine and the centrifugal pump, each to operate at its most efficient and best speed for the conditions, that is, to permit of the proper turbine speed in order that the turbine may be efficient and at the same of reasonable cost and of good mechanical construction, and to allow the pump to operate at a speed consistent with the head and capacity. This speed compromise can best be accomplished by speed reducing gears of the double helical type, which is the most efficient reliable and satisfactory form of drive that can be used.

Pumps for Steam Power Plants.

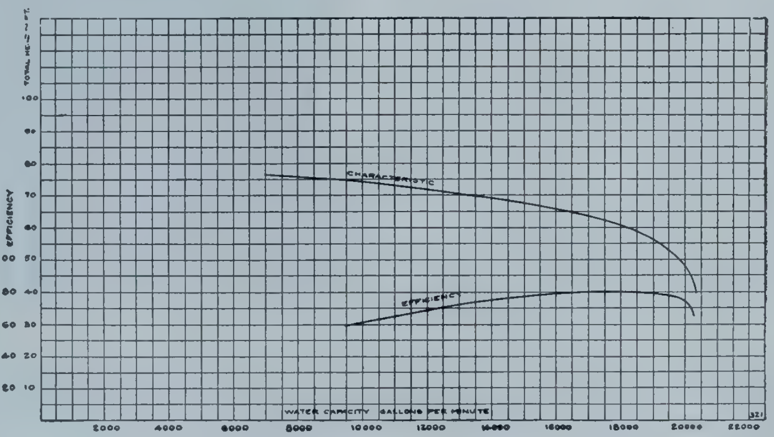
Outside of general water service, the principal applications of centrifugal pumps in steam power plants are for boiler feeding, the supply of circulating water for surface and barometric condensers and for use as hot well pumps for surface condensers and tail pumps for jet condensers.

The cenutrifugal boiler feed pump is rapidly becoming the standard type of boiler feed pump for large power plants. It gives a continuous flow of water without shock or water hammer; it is favorable to the use of boiler feed regulators and water meters of the Venturi and Pitot tube types; it requires little lubrication and the minimum of attention and, due to the absence of reciprocating parts, plungers, valves, packings, etc., the maintenance cost is low.

Because of the high head, ranging from 300 to 600 feet, centrifugal boiler feeders are ordinarily built with from two to four stages, according to the type of drive.

Condenser Requirements.

The requirements of condenser work vary greatly. In circulating water through surface condensers, the head to be overcome consists of two parts; first the static head, which is fairly constant, and second, the friction head which increases as the square of the flow and which is due to the resistance in the condenser and piping. Due to the great variations of head and capacity required, the most efficient manner of regulating the flow is by means of a variable speed prime mover. On the other hand, there is a great advantage at times in driving all of the condenser auxiliaries, including the circulating pump, hot well pump and air pump, from one prime mover, which since the requirements of the several units do not coincide, usually results in the use of a constant speed drive.



TEST CHARACTERISTICS OF A DELAVAL 24-INCH SINGLE-STAGE PUMP FOR CONDENSER SERVICE, 18,000 GALLONS PER MINUTE AGAINST 60 FT. HEAD, 650 R.P.M. PUMP DRIVEN BY GEARED VELOCITY-STAGE TURBINE.

Where the total head to be overcome fluctuates widely, due to tide, rise and fall of rivers, etc., a pump with a comparatively steep characteristic is most suitable for constant speed drive, since considerable variations in the head may take place without greatly varying the amount of water delivered. On the other hand, where the static head is constant, as in cooling tower work or pumping from a lake, a flat characteristic is more suitable, as it permits of varying the amount of water used through wide limits without greatly affecting the head or efficiency of the pump. In all cases, the circulating water system should be arranged on the siphon principle as far as possible in order to reduce the amount of work to be done.

Barometric Condenser Feature.

With barometric condensers, the conditions of operation are somewhat different from surface condensers, due to the fact that the circulating pump should be able to force water into the condenser before the vacuum is established; that is, the pump must be able to overcome the entire static head from the suction well to the head of the condenser. After the vacuum is established, the head to be overcome by the pump is reduced by some 25 to 30 feet and the pump should deliver at the lower head at its best efficiency, which requires a pump having a steep head-capacity characteristic similar to that shown in Fig. 334.

In jet condensers of the so-called "low level" type, the amount of water is regulated by adjusting a valve at the inlet of the condenser and the duty of the pump is to remove the water from the condenser against atmospheric head, plus, in some cases, a constant head due to a cooling tower. A pump with a flat characteristic curve is therefore suitable, as with a slight drop in the pressure to be overcome, as occasioned for instance by a slight drop in vacuum, it will be able to handle a much greater quantity of water, while running at constant speed.

Surface Condenser Feature.

A similar service in the case of surface condensers is that of removing the condensate from the hot well. Pumps of this class must be so installed that there is sufficient head on the suction to give the velocity required at the eye of the pump, the pressure within the condenser under high vacuum not being sufficient to serve this purpose.

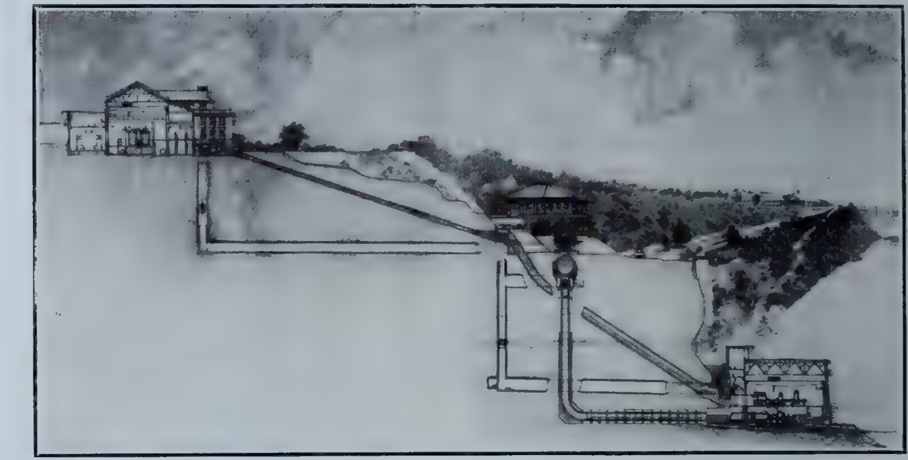
Hydro-Electric Plant of Ontario Power Co., Niagara Falls

In view of the fact that the work of the Hydro-Electric Commission of the Province of Ontario has not only been the means of stimulating and widening the scope of industrial activity, but has in addition brought to the homes of citizens of towns and villages scattered over a wide area, the civilizing influences accruing from reliable and moderate-priced electric current service, it seems not inappropriate to give here a brief account of the main generating station from which the bulk of that service is received.

AMONG the modern power plants which are making efficient use of the energy supplied by nature in the form of falling water, that of the Ontario Power Co., of Niagara Falls, Ont., is a good example.

The general plan of the company's development is as follows: — Water is taken from the river at a point on the Canadian shore about a mile above the crest of the Horseshoe Fall, and just above the rim of the first cascade of the upper rapids. After being thoroughly freed from floating ice and debris, it is conveyed through steel and concrete conduits laid underground and steel penstocks tunnelled through the solid rock, to the generating station situated at the base of the cliff below the Horeshoe Fall. The electrical energy here generated by means of turbines and generators is transmitted by underground cables to the distributing station located high on the bluff above. From this station radiate the transmission lines which convey the power to the various enterprises depending upon it.

In the winter and spring large quantities of ice come down the river, floating on the surface for the most part but with enough suspended in the water to impede the successful operation of the plant, were it not removed at the headworks. For this purpose a long intake dam stretches out into the river in a down-stream direction, almost parallel to the current, admitting to the forebay only the water at the bottom of the river, while ice and floating debris are carried to the rapids by the swift current that sweeps along its outer face. In the comparative quiet of the outer forebay more ice rises to the surface to be similarly skimmed off at the screen house, where the water is further cleansed by heavy iron screens. At the gate-house the water is again skimmed and finally admitted to the main conduits through large electrically operated gates.



SECTION THROUGH GENERATING AND DISTRIBUTING STATIONS SHOWING TUNNEL APPROACHES.

Intake Arrangements.

The design of these intake or headworks is as unique as their operation is successful, for during the nine winters they have been in operation, there has not been a moment's interruption from ice—a record which is unprecedented for power plants in a climate like that of Niagara. The gate house contains the gates, electrically operated, which regulate the flow of water from the inner forebay to the conduits. One of the gates was completed in 1905, the second in 1910, and one more will be required for the complete development.

From the gate house, two 18-foot diameter steel and concrete conduits lead the water underground through Queen Victoria Park for a mile, the first conduit terminating at the overflow and the second at the surge tank. The purpose of the overflow and surge tank is to prevent undue rise of pressure in the conduits in case of a sudden decrease in the amount of water required for power, the surge tank also serving to provide water for an increase in power while the water in the conduits is accelerating.

Adjacent to the overflow and surge tank, steel penstocks 9 feet in diameter, lead downward from the conduits through electrically-operated valves located in a room hollowed out of the rock, to a level slightly below that of the generating station floor, then extend horizontally to the turbines. Each penstock supplies one turbine unit. From the turbines, the water is discharged through draft tubes, and returns to the river under the outer wall of the generating station.

At present fourteen generators are installed, with a total capacity of 169,000

DISTRIBUTING STATION, ONTARIO POWER CO.

horse power, all being of the horizontal-shaft type and direct connected to the balanced twin turbines. Two 1,600 horse power turbine-driven, alternating current dynamos furnish power for individual motor-generators which supply the exciting current for the large machines.

Cable tunnels and conduit systems lead from the generating station to the distributing station on the hill. The electrical power is thus conducted in lead-covered cables to the bus-bars. From the bus-bars, a part of the power is distributed through cables to the transformers, where the voltage is stepped up from 12,000 to 60,000 volts. At this voltage it is sent out on the lines, some of it going as far as Syracuse, N.Y., one hundred and sixty miles away. The power for use in Canada is sent out at 12,000 and 30,000 volts, to the many industries in the vicinity of the plant and along the Welland Canal, and to the system of the Hydro-Electric Power Commission of the Province of Ontario for transformation and distribution at 110,000 volts.

In the central compartment of the distributing station are grouped all the devices for operating the various oil switches, and for controlling the voltage and speed of the generators. Here also, are the meters, which not only show what is occurring at each instant in the power circuits, but record it for future reference. Here, too, is the central switchboard of the private telephone system, over which it takes but an instant to call up any station on the network of power lines. This system of central control is original with this plant, and, like the scheme for diverting ice at the intake works, is as successful as it is unique.

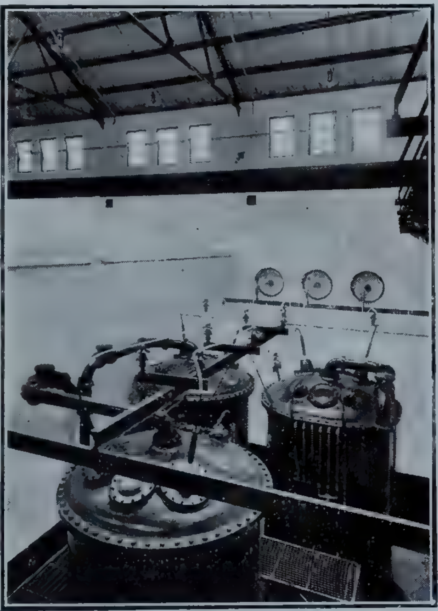
THE PLANT IN DETAIL.

The total drop in the Niagara River in its course of 36 miles between Lake Erie and Lake Ontario is 326 feet, of which 216 feet is in the falls and the rapids immediately above them. The American Fall is 167 feet high and 1,000 feet in width, while the Horseshoe Fall is 159 feet high and 2,600 feet in width. The greatest depth of the river immediately below the falls is about 192 feet. It is estimated that an average of 222,400 cubic feet of water passes over the falls each second. This is 25,000,000 tons an hour, or about one cubic mile a week, and represents a kinetic energy of nearly 5,000,000 horse power.

Headworks.

At the headworks of the Ontario Power Co. the river is 3,400 feet wide and flows at an average velocity of about 8 feet per second.

The intake, constructed of reinforced concrete, is nearly 600 feet long, and is divided into twenty-five bays, while the concrete curtain, which deflects the surface current, extends 9 feet into the water, which is here 15 feet deep. Through these bays or openings in the intake, water is admitted to the outer forebay, with an entering velocity of 5 feet per second. Provision is made for inserting stop logs into each of the twenty-five openings in order to regulate the flow of water.



VIEW IN TRANSFORMER ROOM.

The outer forebay, having an area of 8 acres and a depth ranging from 15 to 20 feet, is bounded on its down-stream side by a submerged wall or dam, over which a large part of the water which enters the forebay is returned to the upper rapids, bearing with it such ice and debris as succeeded in passing the intake curtain. This wall is 725 feet long and terminates at the down-stream end of the screen house.

The screen house is 320 feet long, built of reinforced concrete faced with Roman stone. Broad, ornamental stairways at either end lead to the roof, where a spacious promenade, open to the public at all times, commands a magnificent view of the upper rapids. The water at the screen house is 20 feet deep, and a 5-ft. concrete curtain wall again admits only deep water through the screens to the inner forebay.

The inner forebay forms a quiet pool of 2 acres area and 20 to 30 feet depth, where the water has a final opportunity for being cleared of foreign matter, before entering the conduits.

The gate house, similar in construction to the screen house, is 120 feet long, and is divided into six bays, two for each main conduit. The entrances to the conduits are guarded by Stoney gates, 18-foot and 20-foot respectively, weighing about 40 tons each, including the counterbalances. The gates were built by Ransomes & Rapier of London, England, and are operated by electric motors.

Conduits and Penstocks.

No. 1 main conduit is 18 feet in diameter, 6,300 feet long, 254 square feet in cross-sectional area, and is made of half-inch steel plate with stiffening rings half way round the top at intervals of 4 feet throughout its length. It is entirely encased in concrete, and covered to a depth of from 4 to 10 feet with earth and rock backfill. It terminates in a massive overflow structure of reinforced concrete, containing an adjustable weir of stoplogs, over which the surplus water is discharged through a spiral tunnel to the lower river.

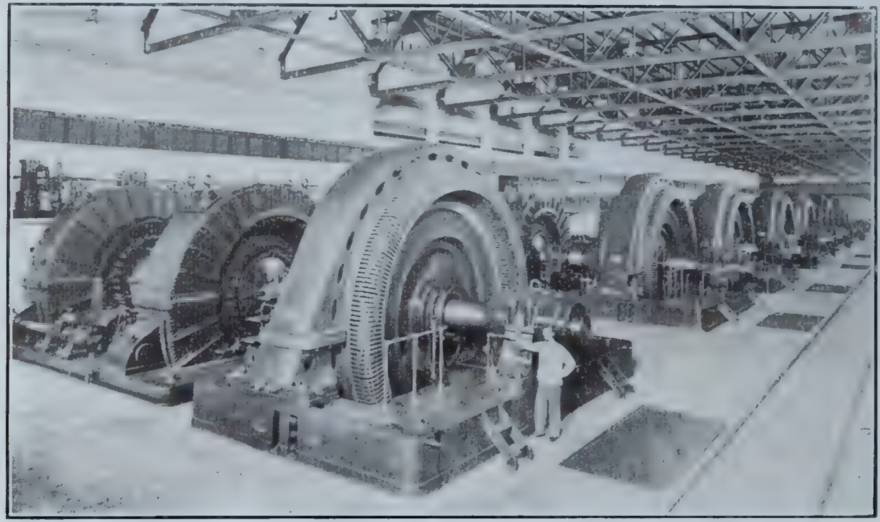
No. 2 main conduit has the same cross-sectional area as No. 1, but is oblate in shape, having a vertical dimension of 16½ feet and a horizontal dimension of 19¼ feet. It is constructed entirely of reinforced concrete and consists of a shell 18 inches in thickness supported by a continuous concrete saddle. This conduit terminates in a reinforced concrete cylindrical surge tank, 75 feet in diameter. The water from the conduit has access to the tank by flowing over the top of a vertical riser 60 feet in height, and

CONTROL ROOM IN DISTRIBUTING STATION.

also through a large opening or port at the bottom. The surge tank accomplishes the double purpose of storing excess water when the load on turbines is reduced, and of supplying water to the turbines for an increase in load while the water in the conduit is accelerating. This manner of regulation is most efficient, as no water is wasted and all that enters the conduit from the forebay is conserved. The surge tank also permits of shutting off any waste water from the overflow of No. 1 main conduit while still maintaining adequate regulation.

Valve Chambers.

Valve chambers are built beneath the lower ends of the main conduits. These chambers are approximately 300 feet long, 10 feet high, and 16 feet wide, and have arched concrete roofs to support the conduits above. Large tapered cast and plate steel intakes lead down from the conduits to the 9-foot valves here located. The first six valves were built by Ransomes & Rapier, and are intended to withstand pressure from above only, while the two valves for the seventh unit were built by Pratt & Cady, of Hartford, Conn., to withstand pressure on either side, as they admit water to this unit from either No. 1 or No. 2 conduit. The valves for units 8 to 12 were built by the Chapman Valve Mfg. Co., of Springfield, Mass., and like the first six, are designed to withstand pressure from above only.



INTERIOR OF GENERATING STATION, ONTARIO POWER CO., NIAGARA FALLS.

Valve Operation.

Each valve is operated by a 30-horse power induction motor, and may be fully opened or closed in about 5 minutes. The two 4-foot valves for the main exciter units are of the more recently developed Johnson type. They require no motors, gears, or hydraulic cylinders for their operation, the actuating force being the water pressure itself within the valve body. These have proved so satisfactory that similar valves, 9 feet in diameter, were used for the thirteenth and fourteenth main generating units.

The penstocks are carried through tunnels and shafts excavated in the rock cliff behind the generating station. They are of 9 feet inside diameter and vary from 225 to 307 feet in length. They are built of steel plate increasing from ⅜-inch thick at the top to ⅞-inch at the bottom.

Generating Station.

The mean water level here is 343 above tide, though it varies from 338 to 365. The walls of the generating station are of concrete, the rear wall being 12 feet thick at the bottom, and the river wall, 9 feet.

The turbines are of the inward-flow horizontal twin type, twelve of these being manufactured by J. M. Voith, Heidenheim a. d. Brenz, Germany, and two by the Wellman-Seaver-Morgan Co., Cleveland, Ohio. Seven are of 12,500 and seven of 13,400 horse power capacity each, operating under the normal effective head.

The generators have the following characteristics:—Speed, 187½ revolutions per minute, 3 phase, 25 cycles, 12,000 volts. Three are of 10,000, four of 12,000, and seven of 13,000 electrical horse-power capacity each. Seven were built by the Westinghouse Electric & Mfg. Co., Pittsburg, Pa., and seven by the Canadian General Electric Co., Peterboro, Ont.

Five of the governors were made by the Lombard Governor Co., of Ashland, Mass., and nine by J. M. Voith. All operate by means of oil under pressure.

The main exciter plant comprises two units, each consisting of a 1,600 horsepower turbine; a 900 k.w., 2,200-volt, 3 phase, 25 cycle, 375 r.p.m., a.c. generator; a special 2,200-volt induction motor, and a 25 k.w., 125-volt direct current generator, mounted on a single shaft. They were built by Allis-Chalmers-Bullock, Ltd., Montreal, Quebec. These units are located in a central exciter bay, the floor of which is elevated seven feet above the main floor. The turbines are supplied with water through 4-foot penstocks which connect with No. 2 main conduit through one of the cable tunnels. The function of the special induction motors is to drive the 2,200-volt generators in case of accident to the turbines, thus minimizing the possibility of failure of the exciting current. Each exciter unit is of sufficient capacity to supply current for driving all the individual motor-generator exciter sets, one of which supplies each of the 12,000-volt generators.

The individual exciter sets, one for each 12,000-volt generator, are driven by the independent supply of current from the main exciter plant. Each consists of a 60-75 horse power 2,200-volt, 750 r.p.m. induction motor, and a 40-60 k.w., 200-volt, direct current generator, located in the gallery adjacent to the 12,000-volt unit which it supplies.

Interstation.

The cable tunnels lead from the generating station to man-holes just above the main conduit. Each is 285 feet in length and inclined at an angle of about 30 degrees from the horizontal. The side walls of the tunnels contain tile ducts which carry the 12,000-volt, three-conductor power cables, two for each generator. The control, low voltage, and service wiring is carried in iron ducts suspended from or built into the roof. From the upper ends of these tunnels to the distributing station, a distance of 320 feet, the cables are carried in standard underground conduits.

Distributing Station.

This building, of red brick with limestone trimmings, occupies a commanding position on the bluff overlooking the Gorge and Cataract. It is absolutely fireproof in construction, and contains, in addition to its electrical equipment, the offices of the company.

The 12,000-volt bus structure is of the semi-enclosed form and built entirely of reinforced concrete. After leaving the three-conductor cables, each wire of the system is carried in a separate compartment, isolated from every other.

The oil switches for controlling the 12,000-volt circuits are arranged in groups corresponding to the generating units, and are operated electrically from the control room.

The transformers are of 30,000 k.w. capacity, 12,000 to 60,000 volts, oil insulated and water cooled. They are grouped in threes, each group being separated from the others by a fireproof wall. Each transformer is enclosed in a steel tank capable of withstanding an internal pressure of 150 pounds per square inch and immersed in 70 barrels of oil.

The normal capacity of the eighteen transformers installed is 72,000 horse power, with overload capacity of 25 per cent.

The high-tension bus is of the open type of construction and is in a separate compartment away from other apparatus. Circuits leading to and from this bus are controlled by electrically-operated oil switches.

The low-tension feeder bus, corresponding in position and use with the high-tension bus, is fed from the main 12,000-volt bus and feeds, through electrically-operated oil switches, the low-tension transmission lines. This construction enables each of the latter to be separately controlled, resulting in maximum reliability of service.

The control room is a spacious apartment located high up in the center of the building, where all disturbance is reduced to a minimum and highest efficiency of operation may be had. It contains the control pedestals and indicating instrument stands corresponding to the generating and transforming units, feeder switchboards, alternating and direct-current service switchboards, voltage regulators, and telephone switchboard. It is connected, through fireproof doors, with the other compartments of the building containing the switches, transformers, buses, etc.

On a mezzanine floor below the control room are located all the recording and integrating instruments, for measuring the output of the station. On a still lower floor are relays for automatically opening the circuits in case of trouble, and the fuse and terminal boards, for the control and instrument wires.

Lightning protection is obtained on the 60,000-volt lines by means of electrolytic lightning arresters, mounted outside of the station, and choke coils between the transformers and the high-tension bus. Horn-gap arresters are also installed. On the 12,000-volt lines this protection is obtained with the same type of lightning arresters, but mounted inside the building in an isolated compartment especially provided for them. Choke coils are also installed in each circuit between the line and the feeder bus.

Transmission Lines.

Two 60,000-volt lines run from the distributing station six miles to a point on the Niagara River near the town of Queenston, where they cross the Gorge and connected with the lines of the Niagara, Lockport and Ontario Power Co., delivering power for use in the United States. These lines consist of aluminum conductors 1⅛ inches in diameter, carried on steel towers 55 feet high to the top wire, with an average span of 500 feet. The insulators for this line are of porcelain and weigh 35 pounds each.

ELECTRICAL PROTECTIVE DEVICES.

WRITING in the Vulcan of September, J Gardner says the protective devices installed in modern generating stations probably represent the highest standard of design and workmanship in the entire installation, and the cost of the switchboard frequently falls not far short of the generating plant it controls. In the old days, however, few or no protective devices were installed. For instance, in a power station still running there are several 2000-volt 300-kilowatt single-phase generators controlled by open single-pole switches of the simplest type and without even a fuse in circuit; one side of the system is earthed. Everything operates quite satisfactorily until a cable goes to earth or someone makes a mistake; then there is a serious accident.

CORPS OF ENGINEERS RAISED AND MAINTAINED BY THE CANADIAN GENERAL ELECTRIC CO. FOR SERVICE DURING THE WAR.—FROM LEFT TO RIGHT:

Back row, standing: H. S. Elliott, Charles Stewart, C. Pink, W. J. Swanger, F. G. Jackson, H. Williams, E. S. Shill.

Front row, standing: Capt. Ritchie, A. T. McLean, W. S. Johnson, J. S. Dunlop, G. Hillier, C. Henry, George Monaghan, A. Hardie, J. C. Munro, C. C. Rous.

Front row, seated: P. Foster, E. Crockford, H. S. McKean, A. J. Palmer, R. W. Nurse, H. Galvin, R. Bethune, H. Bestard.

A case of this kind recently occurred. A direct-current generator coupled to a steam engine was being run up in readiness for paralleling with other machines. When the volts were about 100, the attendant closed the main switch by mistake. Although the fault was discovered immediately, the rush of current into the machine pulled the armature winding partly round the core, and some of the commutator segments were nearly forced out of the V rings. The driving pins in the armature were sheared off and the insulation of the core was damaged. The armature had to be entirely re-wound and the commutator rebuilt.

* * *

ELECTRIC LAMP INDUSTRY BENEFITS BY WAR.

THE tungsten and incandescent lamp industry in Canada will benefit through the industrial conditions created by the war. There have been large importations of tungsten and incandescent lamps from Continental Europe into Canada, and these importations will be greatly curtailed, if not completely cut off, as a result of the war. This will result — indeed has resulted already—in greatly increased demands upon the Canadian manufacturers of these articles.

When the war broke out the plant of the Canadian Tungsten Lamp Co., at Hamilton, was shut down for the summer. Under ordinary conditions operations would not have been resumed until September 15. In view of the probability of an increased demand on account of the war the plant was put in operation on August 15—a month ahead of the usual time. Since operations were recommenced the staff has been employed several nights a week in an effort to keep up with the demand.

Although the present output of the plant is 75 per cent. greater than under normal conditions, it is not sufficient to meet the increased demand. Recently three large orders, which under normal conditions would have kept the plant busy for three weeks, were refused because of the difficulty of filling orders already in hand.

The plant of the Canadian Sunbeam Co., in Toronto, was reopened on July 28 after the usual thirty-day summer shut-down. This plant has been operated ever since at full capacity.

* * *

R. A. Ross, consulting engineer of Montreal, has been appointed by the city of Peterborough as their representative on the board of arbitration appointed to settle the question with regard to the taking over of the plant of the Peterborough Light & Power Co. by the city.

Power Transmission Section

OVERHAULING A DAMAGED THRUST BEARING.

IN a recent number of the Journal of the American Society of Naval Engineers there appeared the following paper covering the Overhaul of a Damaged Thurst Bearing, by Lieut.-Commander H. C. Duigen, C.S.N.

In the four-shaft Parsons turbine installation where a h.p. and i.p. cruising turbine are employed, the two cruising turbines being on the inboard shafts, there is considerable excess propeller thrust on the l.p. thrust collars, whose shaft also carries the i.p. cruising turbine, when going up to speeds near the limit of this combination. Under these conditions, with the propeller thrust taken on the lower shaft rings, the l.p. thrusts of the shafts that carry the i.p. cruising turbine are quite susceptible to heating, and this thrust has been burned out on several vessels. There is usually sufficient surface in the l.p. thrust collars, and the thrust will operate quite satisfactorily provided the bearing of a sufficient number of the collars on their surface is true.

On one vessel this thrust operated without trouble for a long period, until one day, when it was desired to speed up to 19 knots quickly, the thrust heated rapidly and could not be cooled till the combination was shifted so as to release the excess thrust and allow the rotor to move out. Previous to this, speeds as high as 20 knots had been run on this combination for long periods with thrust quite cool. In connection with this matter it has been noted that the rotor comes in harder, and there is considerably more propeller thrust when in shoal water. The worst condition for heating is therefore in speeding-up quickly on the i.p. combination in shoal water. When the vessel is by herself this condition can be avoided to some extent, but when in formation any speed called must be quickly given.

Revealing the Trouble.

On anchoring, the heated thrust was examined, and about six of the collars and rings were cut and roughened. The surfaces were cleaned and stoned; but as there were only a few hours available to do this work, a thorough job could not be made of it. On trying this thrust again on the i.p. combination, it again heated up at about 17 knots. During an overhaul week, a few days later, the thrust was carefully examined. The clearance on bottom rings and go-ahead side of collars was measured by feeler gauges, with shaft in position, at intervals of 90 deg. The readings conclusively showed that the surfaces of the collars did not run true. The heated collars also showed that the most intense heat was at one part of the circumference, and this was the same part of the circumference on all the collars. Squares and straight-edges placed on the surfaces of the collars also showed that the collars were far from being true, and that they were not parallel to each other or normal to the axis of the shaft.

Spotting the shaft collars with red lead and bringing the thrust wings up to bear, and then revolving the shaft also clearly showed that the collars ran out, and the collars that bore touched only in spots on one side. The flange of the thrust shaft was trained to see whether the shaft ran out. The differences for different points of the circumference were so slight that it was apparent that the shaft itself was not bent. From the measurements taken it appeared that the surfaces of collars had not been machined true, but that there had been sufficient bearing surface to allow the thrust to run cool till, on account of some special circumstances, due perhaps to speeding-up quickly, an excessive load was produced and the heating resulted.

Remedying the Trouble.

To remedy the defective conditions, the following procedure was adopted:—The lower thrust-block shell carrying the rings taking the go-ahead propeller thrust was carefully cleaned up and put in place. The surface of the collars was carefully covered with red lead, the thrust brought up to touch, and then the shaft revolved. The first spotting showed number 6 collar to bear hard in two spots, and about five other collars bearing slightly in streaks for about 40 deg. on one side. The spots were then filed and the spotting process repeated. The second spotting showed about eight collars bearing in streaks part of the way around. The third spotting showed about ten collars bearing in rather heavy streaks about half-way around. Filing was then stopped, as it was feared to take off too much metal, and time was also limited.

Grinding-in Process Adopted.

A novel grinding-in process was then tried. The lower thrust block was put in place. A dummy adjustment jig which permits of rotors being moved in or out with a ratchet gear was rigged over the thrust collars to keep rotor in place. A mixture of bathbrick and oil was put on the thrust bearing and the turbine rotated at about 25 revs. with steam. The collars were brought to bear by means of the jig, and were moved up slightly tighter as the grinding proceeded. The supply of powdered bathbrick and oil was continually replenished while the grinding was going on. The brick-dust and oil ground the surfaces in contact and tended to smooth them up. As the collars are of hard steel and the thrust rings of composition, most of the grinding would be done on the rings, however, some grinding and smoothing-up of steel surfaces would also result. This grinding was continued for about 2½ hours. The thrust block was then taken out and all parts of rings and collars carefully cleaned and replaced. After these adjustments were made, the thrust, though regarded with suspicion, ran satisfactorily up to nearly 18 knots on the combination for nearly three months, but on another occasion when necessary to speed up quickly in shoal water, it again heated badly.

The vessel arrived at the navy yard shortly after for a two weeks stay, and thus an opportunity for more carefully overhauling the thrust presented itself. The shell containing the rings was taken to the shop, and the edges of countersinks and all oil grooves were carefully milled out and the surfaces carefully smoothed up. The surfaces of collars were carefully dressed up with file and scrapers by two navy yard mechanics especially expert at this work. Then the process of spotting the collars with red lead and filing down high spots was repeated, but this was done more often than on first attempt. The work took two machinists six days.

When this spotting and filing had progressed so far that a fair bearing was obtained on most of the collars, and all the collars touched at some points, the surfaces were again ground in a bath of oil and brickdust for about three hours, running the turbine with steam at about 30 revs. per min. Everything was again carefully cleaned out. The process of cleaning out, spotting, and filing, and finally grinding-in, ensured surfaces being smooth. When the thrust was tried soon after this to the practical limit of the I.P. combination, it operated satisfactorily. This method of grinding-in a bearing is perhaps somewhat novel, but it appears to be quite effective, and accomplishes what might otherwise require a large amount of labor.

OPERATION OF TRANSMISSION MACHINERY.

By Lycurgus Carson.

WHILE the trend of thought of mechanical engineers and millwrights seems to be towards the perfection, from an efficiency point of view, of the power generators and the machines which use the power, the means of getting the energy from the source to the work has, by no means, received such careful consideration. The transmission system is, in fact, one of the items classified as non-productive investment and, for this reason if no other, gets put into the hands of incompetent persons or is more or less neglected altogether.

Electrical transmission furnishes the one glowing exception to the above assertion and, when once installed, offers little room for increasing its efficiency except by supplanting the equipment with new and more up-to-date apparatus. Have more capable minds been devoting themselves to the electrical form of transmission than to the line shaft, gears and belts? Ordinary line shafting which still predominates in our factories, and is likely to for some time, is rarely operated within even a reasonable range of efficiency. So long as the driving power is ample and the bearings do not smoke, no concern is felt and no investigations are made. In fact few mechanics have any idea of the amount of power that should reasonably be consumed by shafting and bearings.

A Plant Example.

In a plant of which the writer took charge some years ago, considerable power was required to operate machinery. This power was furnished by an automatic high speed engine, whose exhaust steam was used for heating and cooking processes which were such that a back pressure of 5 pounds could not be prevented. The engine was in charge of a very competent engineer but, in spite of the fact that he had done everything possible to boost up its efficiency, it was continually overloaded and considerable exhaust steam had to be allowed to escape to the atmosphere. The firm had got to the stage of considering the advisability of either buying current for lighting, or installing an electric motor to take part of the load, and use current from a central station.

After a careful investigation, no way of reducing the load could be found although some rearrangements of machinery and belting were made which helped some. The peak loads were still much beyond the capacity of the engine. However, the engineer was asked to take some cards from his engine on a holiday when no machines were in operation. These cards showed an indicated horse-power equal to 38 per cent. of what was developed when the plant was in full operation. This gave a clue as to where some of the power was going, and a careful study of the great quantity of line shafting was the result.

Each bearing was visited and inspected. Those which showed signs of heating were lined up and re-fitted. Some few of the easily evident cold ones were found to be much too large for the shaft, the babbit having run out of one or two of them altogether at some time or other. Some of the idler pulleys were found to be in as bad shape as the bearings but, on account of being in rapid motion, most of the heat was radiated to the atmosphere. These also were corrected. Much work was found to be done, and the spare time of several mechanics was utilized in this way for six weeks. An indicator calculation made when this work was completed showed that the lost power had been reduced to 9 per cent.

EUROPEAN WAR ISSUE.

Make no mistake about it. Whatever other great issues are involved, the issue is the life, the mission and continued world service of the British Empire.

Much of the shafting was placed in very awkward positions so that oiling and other attendance was difficult. To overcome this, all shaft bearings were fitted with large grease cups. These cups were unique in that they were fitted with a small rachet wheel and lever having a short section of light chain attached. The oiler was provided with a hooked steel rod long enough to reach the fairly large rings on the ends of the chains from the floor. By inserting the hook and giving a slight pull with the rod, the cover of the grease cup would be screwed down one-fifth of a revolution, and if more were deemed necessary, two pulls did the trick.

By this scheme, the attendance was reduced to about one-third, and the cost of grease was found to be very much less than the cost of the oil. The cups were given attention once every two or three days and were filled every two months. The grease cups had to be bought, but the attachments were all made in the plant.

The power required to drive the shafting and loose pulleys was finally cut down to from 6 to 8 per cent. More machinery has since been added, and the engine is using less steam than at any time previously.

MACHINERY BELTING MARKETS.

BRITISH manufacturers of leather, hair, and cotton belting for machinery will be interested in a memorandum just issued by the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall street, E.C., showing the principal markets to which German and Austrian goods of this class have been exported. Although German exports of these products do not appear to rival those of Great Britain in value, they are in some directions very considerable. To these, however, no less than $493,500 worth of belting from Germany has been sold in a recent year, most of it being of other classes than leather, cotton, or wool.

In other countries the sales are also large. For instance, Germany sold to Russia recently in one year leather belting to the value of $658,500; to Sweden to the value of $114,750; Italy, 115,000. Of German woven hair or cotton belting, Russia took $353,500 worth; France, $70.750, and so on. Roumania is a large purchaser of all classes of German beltings, though latterly the country has developed an industry of this kind itself. France takes a considerable amount of woven belting from Germany. The Russian trade was formerly in the hands of British firms, but has been captured by German efforts. In 1912 Germany's total exports of belting were worth $3,675,000.

* * *

High-speed Steam Engines—In a recent paper on this subject, the author, in speaking of the long runs made by high-speed steam engines, instanced the case of one engine which only stopped for five hours in twelve months, running 8.755 hours out of 8,760. Another fact, dispensing with the old-fashioned theory that the engines would rack themselves to pieces, was that an engine ran from July 1 to November 30, making 85,000,000 revolutions. At a colliery in South Wales an engine which had its low pressure cylinder cut out in an accident, ran for six months on the high pressure and intermediate cylinders without stopping.

Service Data for High Speed Bearing Loads and Velocities

By Gerald Stoney, F.R.S.

The observations contained in this article make a timely contribution to a subject that is more or less largely engaging the attention of designers and operators of high-speed mechanical engineering equipment in a wide field of application. The information given, being for the most part that obtained from test and experiment and actual service, carries with it, therefore, merit of exceptional value.

THERE are three principal types of friction in all bearings:—

1.—Contact friction, where both surfaces are dry, and this type was investigated as early as 1781 by Coulomb, who found for pressures from ¾ lb. to 100 lb. per sq. in., and speeds up to 10 ft. per second, that the friction was independent of the pressure per square inch and the velocity, but was proportional to the total force pressing the surfaces together, and was dependent also on the nature and material of the surfaces.

2.—Greasy friction, where there is more or less complete lubrication and a more or less complete film of oil between the surfaces. This has been investigated by many experimenters, but concordant results have not been obtained, as so much depends on the degree of lubrication. Generally speaking, however, friction of this kind is proportional to the load, and is independent of the speed—i.e., the coefficient of friction is constant.

3.—Complete lubrication where there is a complete oil film between the surfaces and there is no metallic contact, This usually occurs in high-speed journal bearings where bath or forced lubrication in some form is provided.

Experimental Results.

The chief published experiments on high speed bearings are those of O. Lasche, and the general result of his tests show that so far as friction is concerned it is not well to use a large shaft and a long bearing, although experience shows that for high speeds and heavy loads long bearings are necessary. They have also to be large to avoid vibration and critical speeds, and also the risk of fracture due to vibration. To avoid this latter danger the bending stresses have to be kept to a figure which would be considered very low in ordinary practice, as there have been several cases of fracture of shaft ends. If the pressure is too high, or the oil is too thin, a bearing may run all right so long as there is no vibration; but if vibration occurs, the oil film may be driven out and seizing takes place.

This is especially liable to happen with the staffs of electrical machinery, such as the armatures of dynamos and rotors of alternators, where there is always a liability to vibration due to their going out of balance; and it is probable that much lower pressures are advisable in such cases than in those of turbine rotors, which from their construction are not as a rule so liable to go out of balance. The effect is reduced in very high speed staffs, above say 2,000 revolutions per minute, by the use of the well known Parsons flexible bearing, where there are two or more tubes outside the bearing bush with a small clearance between them in which the viscosity of the oil tends to damp out vibrations.

Size of Bearings.

In turbine work, a rule much used for deciding the size of bearings has been that the product of the speed by the pressure should not exceed a certain figure, but it is doubtful whether this rule is of much value, as it really assumes greasy friction and not perfect lubrication. In land work a product of 5,600 has rarely been exceeded, or 75 lb. per sq. in. at 75 ft. per second. At lower speeds, higher pressures are used satisfactorily, as, for example at about 35 ft. per second a pressure of 130 lb. to 150 lb. per sq. in. is admissible.

In a discussion on Professor Christie's paper before the American Society of Mechanical Engineers in 1912, Hodgkinson stated that speeds of 80 ft. per second and 100 lb. per sq. in. were commonly employed in America, and where there is no risk of heavy vibration there does not seem any reason why higher pressures should not be used. It has to be remembered that the heat to be carried off does not increase with the pressure, and that the real danger lies in the possible breaking down of the oil film by excessive pressure or vibration.

Marine Turbines.

In marine turbines the journal speeds are much lower than on land, and rarely exceed 30 ft. per second, and the pressures are usually 80 lb. to 100 lb. per sq. in.; but there is a strong tendency to increase this latter figure, and it is probable that pressures of 150 lb., or even possibly 200 lb. per sq. in., could be used, especially if the oil temperature does not exceed 100 deg. to 110 deg. Fah., as is usual in marine work. The temperature of the oil is limited by its loss of viscosity at high temperature and by its liability to carbonize and oxidize, and thus cause deposit in the pipes, oilways, etc. In land practice temperatures of 120 deg. to 140 deg. Fah., are common, but it is not well to go above 150 deg. or 160 deg. Fah., as most oils seem liable to oxidize and cause deposit above this temperature. At about 250 deg. Fah. most oils cease to lubricate, as their viscosity becomes too low.

The Friction Feature.

From Lasche's experiments it was found that the friction is approximately inversely proportional to the temperature measured from freezing point; but after a certain temperature the friction rapidly increases and seizing takes place, due to the loss of viscosity. In all high-speed bearings artificial means have to be used to carry off the heat, radiation from the bearings not being sufficient. The general plan is to have such a flow of oil through the bearing as to cause the heat generated to be carried away without an undue rise of temperature. Water-jacketing the bearings has been used in some cases, but it is not as satisfactory in general as the plan of supplying sufficient oil to carry off the heat. Oil-coolers have therefore generally to be provided to cool the oil. In some cases also the oil is circulated round the outside of the bearing in suitable passages so as to assist in cooling it, and this is probably necessary in the case of very large bearings running at high surface speeds. The heat to be removed is not only that caused by friction, but also that caused by conduction from the steam; on the other hand, the bearings near the condenser are cooled by the exhaust steam and heated by the gland steam. From Lasche's tests the heat produced in bearings running at a temperature of about 122 deg. Fahr. is that due to a shear of the oil-film of about 0.46 lb. per sq. in. of the projected area, and this gives as the B.t.u. per hour:—

$$\text{B.t.u} = 2.1\ d\ l\ v$$

where d is diameter of bearing in inches,
l is length of bearing in inches,
v is surface velocity in feet per second.

The constant varies inversely as the temperature above freezing point. A formula which has been often used in marine practice is $\text{B.t.u} = d\ l\ v^{1.38}$, which gives slightly greater results for the usual speeds in marine work, and an oil temperature of about 100 deg. F.

It may be taken that this is approximately the heat that has to be carried off by the oil. Taking the specific heat of oil to be 0.31, and allowing a rise of 10 deg. Fah. in the oil, we require 20 lb. or about one-third of a cubic foot of oil per hour per square inch of projected bearing surface when the surface speed is 30 ft. per second, and 40 lb., or two-thirds of a cubic foot, of oil per hour with a surface speed of 60 ft. per second. In practice these quantities are often increased by from 30 to 50 per cent., to allow of the unequal distribution of oil between the bearings, and to ensure that there is no undue heating, also in some cases to allow for the flow of heat from the steam.

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*From a paper read recently before the North East Coast Institution of Engineers and Shipbuilders.

Ring lubrication was experimented on by Lasche, but the results were found to be very variable, and in general he says that the tests show ring lubrication to be very uncertain and that it should not be used in cases where external cooling of the oil is necessary. As a result of some tests made on a 9 cm. diameter bearing, more oil came out of one side than the other.

Thrust Bearings.

Thrust bearings are generally of the usual collar type with the bottom and top halves separately adjustable to take up end play; and in land turbines, which are practically balanced, the pressures are very low, never exceeding 20 lb. per sq. in., and even in marine turbines 50 lbs. per sq. in. is never exceeded.

There are no tests available as to the friction of such bearings, but it is probable that it is fairly high, as perfect lubrication is difficult to attain, and, as an approximation, the total area—that is, the area of the top and bottom halves together—might be added to that of the main bearings in estimating the quantity of oil required and the surface of the oil-cooler. Such bearings have generally a high coefficient of friction, owing to the low pressures employed, since, as it is impossible for a wedging action to take place and thus admit the oil, such as has been described as occurring in the case of journal-bearings, the lubrication is rarely perfect. Towers found at moderate speeds that the pressure which could be safely carried was about 60 lb. per sq. in., as against 600 lb. in a journal-bearing, and that the shear resistance of the oil film was greater, being 1.5 lb. per sq. in., this giving about sixteen times the so-efficient of friction for a thrust-bearing as for a journal one.

The theoretical consideration of the conditions necessary for perfect lubrication, as set out in Osborne Reynold's Royal Society paper in 1886, referred to above, and also his own investigations, led Michell, in 1905, to devise a thrust-bearing which would admit of perfect lubrication. In this thrust-bearing there are segmental blocks pivoted at the theoretical center of pressure, which is about 0.6 of the length from the leading edge. By this device perfect lubrication is attained, and pressures up to 1,500 lb. per sq. in. can be safely carried at high velocities, with a consequent reduction of the coefficient of friction to about 1-60th of what it is in an ordinary thrust-bearing. Another advantage is that the end play in the thrust-bearing can be greatly reduced.

The same idea has been further developed by Sir Charles Parsons, K.C.B., F.R.S., in patent 8266 of 1912, where the blocks are centrally pivoted. It has been found that, in cases where the pressure comes on gradually, this works equally well in practice, and has the advantage that the shaft may run in either direction without the complication of shifting the point of support. These principles have also been applied to journal-bearings by Michell (patent 23,496 of 1911) and Sir Charles Parsons (patents 8,266 of 1912, 29,810 of 1912, 953 of 1913, and 5,619 of 1913), enabling greatly increased pressures to be used, with a resultant reduction of the coefficient of friction, and also a large reduction in the length of the bearings, and thus of the whole plant. The reduction of friction may in some cases reduce the consumption of steam between 1 per cent. and 2 per cent. in a turbine plant.

Ferranti (patent 5,035 of 1910) has also worked on the same lines, as well as Kingsbury in the United States (American Patent 947,242 of 1910), and there are full details of the latter's thrust-bearing in the Journal of the American Society of Naval Engineers, November, 1912.

In the U.S.S. Neptune a single collar, 13½ in. in diameter, carries 45,000 lb. thrust at 72 ft. per second mean speed surface, or a pressure of 500 lb. per sq. in. and, in general, such turbine thrust-bearings are designed for about 500 lb. per sq. in. at 60 ft. to 75 ft. per second. Much higher pressures can be safely carried, as is shown by some tests carried out by the Westinghouse Co., where pressures up to about 7,000 lb. per sq. in. at 54 ft. per second were carried without heating. The coefficient of friction of such a bearing may be from 0.0008 to 0.003 and, for such a pressure as 500 lb. per sq. in., may be safely taken as about 0.002, or, say, one-tenth to one-fifteenth of that of an ordinary thrust-bearing.

Steam Turbine Thrust Bearing Tests.

The Westinghouse Co., of Pittsburg, made an interesting set of tests on such a thrust-bearing for a steam turbine, the pressure being varied by throttling the balancing-pipe to the dummy piston. The following are the particulars of this bearing:—

Outside diameter of collar, 4¾ in.
Inside diameter of collar, 2⅜ in.
Number of pivoted blocks, 10 in.
Total area of pivoted blocks, 10.4 sq. inches.
Revolutions per minute, 3,470.
Mean surface speed, 54 ft per second.

The blocks were steel faced with white metal, 1-16 in. thick, and were pivoted behind their center of area, and with all the blocks in use, 1,010 lb. per sq. in. was carried without heating. As this was the limit of force which could be applied, the number was first reduced to four blocks, and then to two, the corresponding pressures per sq. in. being respectively 2,620 lb. and 5,420 lb. per sq. in., which were carried without difficulty. The surface was then reduced to 1.9 sq. in., and the pressure rose to 5,910 lb. per sq. in. It was further reduced to 1.2 sq. in., with a pressure of 10,000 lb. per sq. in., but here the white metal flowed in all directions until the area was increased so that the pressure was reduced to 7,000 lb. per sq. in., but no heating occurred.

It is worth noting that the white metal flowed equally in all directions irrespective of the direction of rotation. It is thus seen that the limit of pressure with such a bearing is the flowing of the white metal and not the failure of the lubrication, and that with pressures of 500 lb. per sq. in. there is an enormous margin of safety; it is probable that three times this pressure will be found quite safe in practice.

* * *

EUROPEAN EXPORT OF MACHINERY BELTING.

THE value of machinery belting of leather, wool or cotton, and of other materials exported from Germany and Austria-Hungary in a recent year was as follows:—

From Germany—1912.

Of leather	£ 317,000
Of cotton, wool, or other coarse animal hair	233,000
Of textile materials combined with rubber	185,000
Total	£ 735,000

From Austria-Hungary—1913.

Of leather	£ 20,400
Of cotton or wool	700
Of other materials	2,100
Total	£ 23,200

From Great Britain—1913.

The United Kingdom exports of machinery belting to all destinations in 1913 were as follows:—

Of leather	£ 683,000
Of woven hair or cotton	542,000
Of other materials	394,000
Total	£1,619,000

Leather Belting.

The following statement shows for a recent year the principal markets for German and Austro-Hungarian machinery belting of leather and the amounts sent to each. Figures for the United Kingdom have been added for comparison.

EXPORTS OF MACHINERY BELTING AND LEATHER.

Country to which Exported.	From Germany (1912) £	From Austria-Hungary (1913) £	From United Kingdom (1913) £
Colonial and neutral markets—			
British India	1,300	....	189,400
Australia	500	....	10.800
Norway	2,300	....	2,900
Sweden	22,950	....	6,500
Denmark	6,500	....	1,900
Netherlands	4.350	120	7.400
France	2,350	230	16.300
Spain	1,450	....	2,400
Portugal	1,100	....	7,100
Italy	23,750	690	5,800
Bulgaria	2,100	4,130	1,200
Roumania	13,000	4.330	11,700
Russia	131,700	4.820	176,000
Turkey	3,250	1,150	9,200
Egypt	1,000	....	12,400
Switzerland	16,800	80	1,700
Dutch East Indies	3.950	90	1,500
China	700	....	17,200
Japan	......	....	3.700
Mexico	1.400	....	10,000
Cuba	2,200	....	200
Brazil	6,200	....	33,100
Urugay	2,450	....	2,300
Argentina	8,700	30	25,800
Chile	3.350	....	9,100
Total to above destinations	£263.350	£15,670	£565,600
Exports to United Kingdom	£5.800	£60	

The foregoing statement shows that the United Kingdom holds the bulk of the trade in leather belting in France, Portugal, Egypt, British India, China, Mexico, Brazil, and Australasia, while Germany leads in the Swedish, Danish, Italian, and Swiss markets. German competition is severe in Roumania, Russia, and Uruguay. Austria has a fair share of the trade in Bulgaria and Roumania, but is hopelessly out-distanced by Germany and the United Kingdom in the remaining markets.

* * *

EFFICIENT TRANSMISSION.

By J. P. Sanderson.

THE advantages to be gained by the interchange of visits among plant foremen and managers are nowhere more evident than in the opportunity to compare different systems of organization. Although the essential points—the costs and cash investments—are not often available, the visitor always has the opportunity of adopting expedients into his own organization for experiment which, if carefully carried out, would give much more satisfactory results. In no department is more to be gained by the traveling engineer than in the sphere of power transmission. Everywhere one goes, the individuality of the master mind of the place is evidenced in the different methods adopted to obtain the same or modified results.

The writer once had charge of a heating plant which necessitated a number of long steam mains. The system gave such proofs of efficiency that a neighboring firm adopted a similar arrangement which, however, never seemed to give satisfaction, although it really had less to do. During the second year of its operation the writer was called in to inspect and offer suggestions. The only fault found was that the exhaust steam mains leading to the different heating units were not covered, and insufficient provision had been made for removing the condensation which was the real cause of the difficulty. Upon the piping being well lagged, the trouble entirely disappeared, and the plant has been working satisfactorily ever since.

This instance goes to show that more often depends upon the man in charge of a plant than on the type of machinery employed for its success. Also, a man who favors any particular system is very apt to work it under conditions where it will be inefficient and where another system should be adopted. For a useful comparison, different systems should be operated when in the best or under a similar condition.

Transmission Vagaries.

In the case of power transmission, similar conditions hold. In an Eastern plant known to the writer is located an induction motor driving a line shaft less than 4 feet away through a countershaft carrying about 1,600 pounds of fixtures and 110 feet of ten-inch belting. This machinery is elaborately fenced and much difficulty is encountered in getting men to work continuously under it on account of the draught caused by the belts and pulleys.

In a Western plant again, is to be seen the same type of motor bolted to the ceiling and driving its line shaft through a rocker joint chain. This chain is tightly enclosed and runs in a bath of oil. There is no noise, no wind, no daily oiling and little evidence of loss of power.

In this same plant, whose superintendent is a chain enthusiast, is a chain-drive operating a tumbling mill. This chain is too long to be completely enclosed, and is so located that it is impossible to lubricate it. One of the sprockets requires to be replaced about once a month and the other about once in two months, while the link belt itself has been renewed several times. The power required to wear out this machinery is not only wasted on destructive work, but must be paid for. If this machine were driven by a good leather belt through a tightly enclosed gear and pinion, the above loss would be largely prevented and shutdowns for repairs would not be required oftener than once a year.

In another plant supervised by a very capable master mechanic, but who, by the way, is strong on line shafting and belts, is located a tumbling barrel for the purpose of grinding up the droppings from the cupola. This mill is necessarily located so close to the furnace that the driving mechanism is subjected to considerable heat. A line shaft extension is run 130 feet to operate it and is connected by means of a belt, the speed being considered too great for a chain. On account of the heat it is necessary to replace this belt every few weeks, while a large part of the time the machine is in an unsatisfactory working condition. The obvious cure in this case would be a motor-drive and electrical transmission.

The scheme adopted in a Buffalo plant to operate a stoker could be easily applied to the above case. This consists of a motor directly connected to a chain of gears which reduces the speed to that required by the machines. On the motor spindle is placed a small fan similar to that used behind the radiator of an automobile. The motor and gears are tightly enclosed with sheet metal, a pipe connecting this casing to the outside of the building. The result is that cool air is drawn through the casing into the fire room. When the motor is stopped, there is sufficient natural draft in the sloping pipe to prevent the machine from becoming overheated.

Numerous other cases of ill-adapted transmission schemes have come under the observation of the writer, but the above should be enough to set the man who is inclined to partiality towards any particular system to studying the others. In many new plants the greatest improvements are possible in the power distribution system.

* * *

Isaie Trudel, for 25 years an engineer in the Hull city pumping station, and about 50 years a resident of that city, one of its best known citizens, died at his residence, Notre Dame street, on Oct. 4, at the age of 66 years. The deceased was born and brought up in St. Remi, Que.

The Cedars Rapids Manufacturing and Power Co. Plant

Staff Article

Such hydro-electric power plants as that described in the accompanying article, go to prove conclusively the value of low-head water powers. That turbines and electrical equipment can be designed to successfully and efficiently develop and transform water powers otherwise going to waste into a manufacturing utility and necessity is no longer a dream.

THERE is perhaps no country in the world more abundantly provided with water power than is Canada. Concurrent with our general industrial growth, considerable attention has been given to the harnessing of many of these power sources and their conversion into electrical energy.

For the most part, the machinery for generating electrical energy has been of the high speed type and the most efficient way of combining a generator and prime mover is to connect them directly. Thus, in the earlier developments, only high heads of water could take advantage of this the more economical method. Low heads of water were not considered as desirable as high heads; moreover, the turbines in use always seemed to give better results under the latter. This, notwithstanding there were many thousands of horse power available in the rivers of Canada awaiting the time when they too would be harnessed.

To-day there are many designs of low head turbines which give remarkable results. Electrical machinery has also witnessed a corresponding development and generators can also be obtained which revolve at very slow speeds, and yet are capable of generating the voltages required. Since many designs of larger water turbines are constructed to operate on vertical shafts, the generators too can be procured to suit, with the result that the turbine and generator may be direct connected. As soon as the low head turbines and the slow speed generators had become accomplished facts, the real value of the low head water powers became apparent.

In the St. Lawrence River rapids there exist some of the greatest water powers of the world. About fifty miles west of Montreal this river widens out into Lake St. Francis, and above Lake St. Francis is a long series of rapids known generally by the name of the largest one—the Long Sault. Below Lake St. Francis and nearer Montreal lies another expansion of the river named Lake St. Louis, and between these two lakes the St. Lawrence River falls a distance of about 80 feet, made up principally of three rapids, namely Coteau, the Cedars, and the Cascade. Thirty-two feet of this total fall is in the Cedar Rapids thirty miles up the river from Montreal. The St. Lawrence drains a territory of 300,000 square miles, of which an exceptionally large percentage is lake area. Another feature which makes it very valuable for power purposes is the steadiness of its flow. The ratio of the flow in the lowest and in the highest years being 3 to 1. This low ratio is unique when compared with the Susquehanna River, which has a range of 75 to 1 and the Mississippi 25 to 1.

For many years, the development of power from these St. Lawrence River Rapids has been under consideration. No diversion of the water is permitted without first having obtained the sanction of the International Waterways Commission, thus insuring that the levels for navigation purposes are not affected.

The Canal.

The rapids at the Cedars extend over a distance of about two miles, and in order to use this fall it was necessary to concentrate it at one point. To do this a canal has been constructed along the north bank of the river, the outer wall of which is an artificial bank formed of excavated rock taken from the canal section and made water-tight by clay filling on the inside. This combination rock-fill earth bank has been built with ample factors of safety, and special precautions have been taken to prevent leakage or possible damage to the bank.

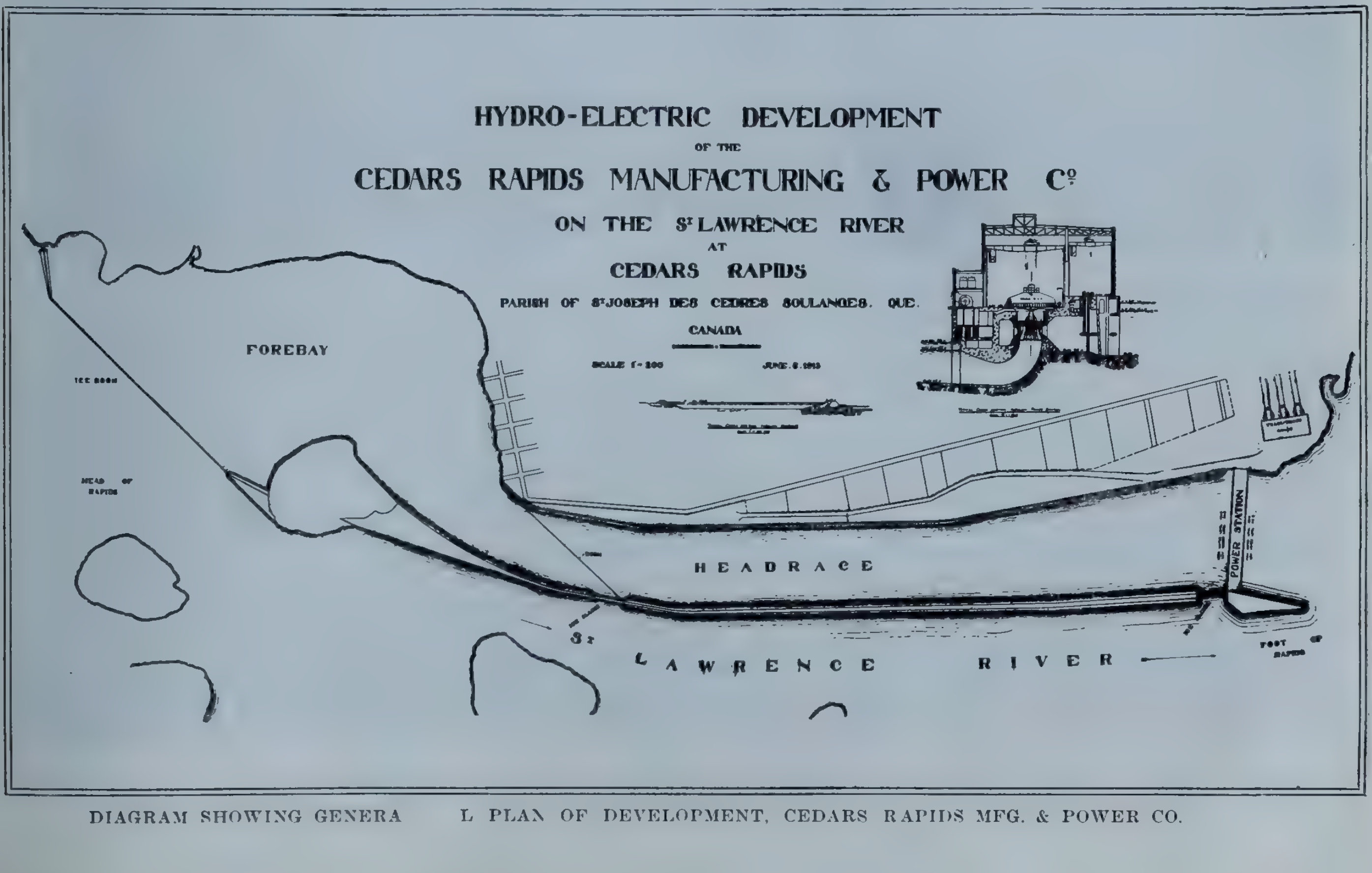

HYDRO-ELECTRIC DEVELOPMENT
OF THE
CEDARS RAPIDS MANUFACTURING & POWER C^o
ON THE S^T LAWRENCE RIVER
AT
CEDARS RAPIDS
PARISH OF S^T JOSEPH DES CEDRES SOULANGES, QUE.
CANADA
FOREBAY
ICE BOOM
HEAD OF RAPIDS
HEADRACE
POWER STATION
S^T LAWRENCE RIVER
FOOT OF RAPIDS

DIAGRAM SHOWING GENERAL PLAN OF DEVELOPMENT, CEDARS RAPIDS MFG. & POWER CO.

The maximum head of water against the bank will never exceed 30 feet, so it is evident that such a construction will give thorough satisfaction. It is being successfully employed in many cases of large reservoirs. The canal when finished will have its outer bank practically a straight line for two miles and, parallel thereto, a similar bank located on the natural flow of the river, at a distance from the outer bank of about 1,200 feet. The width of the canal, however, on the water line will be about 1,000 feet. The total length of the canal from the ice fender above the Isle-aux-Vaches to the power house will be about 12,000 feet.

COMPLETED SECTION OF CANAL (ABOUT MIDWAY), CEDARS RAPIDS MFG. & POWER CO.

Extending across the lower end of the canal and forming a dam is the power house structure itself. The building is of concrete and in the power house is concentrated the total fall of thirty-two feet. The ice fender located at the upper end of the canal consists of a series of submerged openings so that the water entering the canal must be drawn in at five or six feet below the surface. As this ice fender has the same general direction as the main current of the river, the ice will strike this fender and will be carried along down the river by the main current without entering the canal. This fender will not, however, take care of what is known as frazie ice, and special precautions are being taken to prevent interruption from this cause. Very large units are not susceptible to so much trouble from this source as are smaller units, and a very large amount will naturally pass through the wheels, as the openings through the latter are about 7 feet high and 3 feet wide.

The canal is designed to convey 52,000 cubic feet of water per minute to the turbines, and at a rate sufficiently slow to ensure the minimum waste from frictional resistance. This quantity of water is the maximum amount the charter of the company allows them to take from the river. The present plans are such as to eventually produce 160,000 horse power.

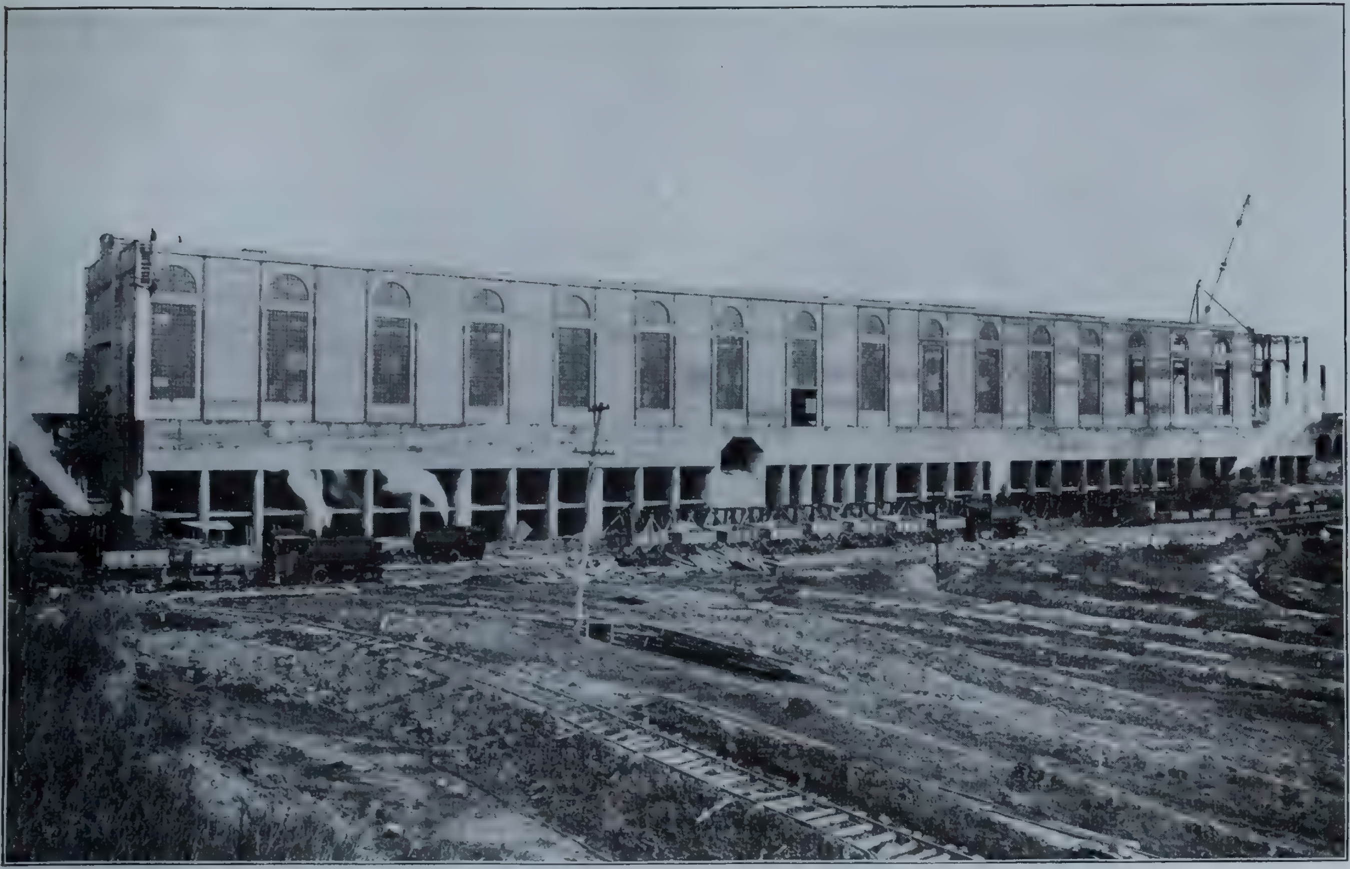
The Power House.

The power house at present is so constructed that an addition can be added. It has room to accommodate ten turbines, nine of which are now being installed. Each wheel is capable of developing under a 32-foot head 10,800 horse power, although their nominal rating is only 10,000 horse power. The proposed extension of the power house will enable it to finally house eighteen turbines. Two of these units will be regarded as spares and the total nominal horse power generated will then be considered as 160,000.

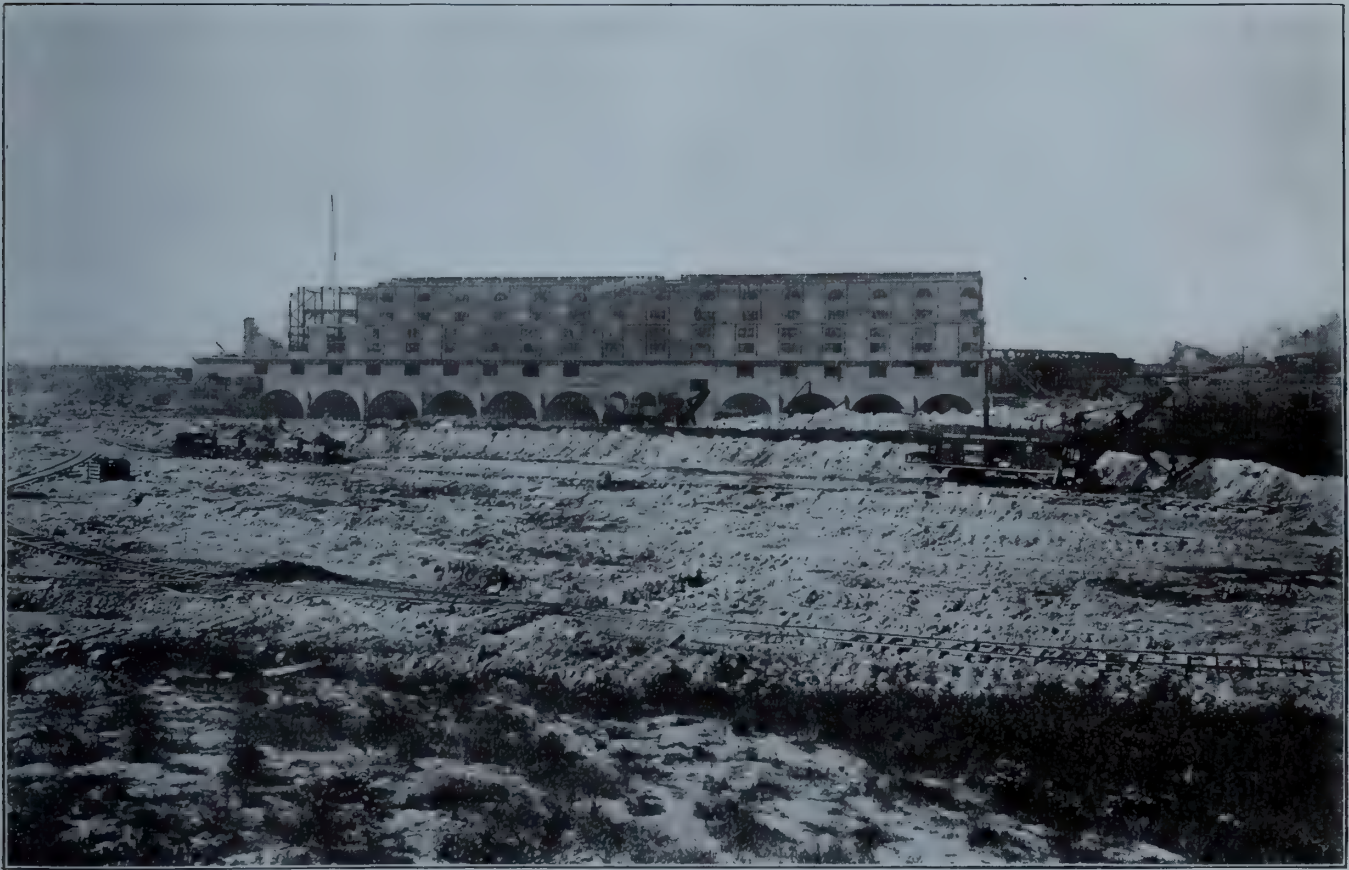
Each turbine is of vertical single unit types, mounted on a 27-inch diameter steel shaft, their diameter is between 17 feet and 18 feet. The generators operate on the same vertical shaft as the turbines, and are 36 feet in diameter. The latest improved design of thrust bearings have been used, and these are located above the generators where they are easy of access. By using this vertical generator mounted on the wheel shaft the very shortest possible length of the combination unit was obtained. The number of guide bearings which hold the shaft vertical is thereby reduced to two in the case of each unit. The thrust bearings will be easily maintained and kept in order, being so very accessible. All parts of the power house are reached by the travelling crane, so that adjustments and overhaul of parts are further simplified.

Each unit has a speed of 55 r. p. m. The wheels are not set down in a pit but are each equipped with a 15-foot draught tube of 18 feet diam. Thus about one-half of the power is obtained by the water falling on the wheel and the other half by the suction of the water in the draught tube. The vertical wheels were chosen rather than those of the horizontal type because of the low head. In large units such as these, under the low head the horizontal type of wheel does not lend itself to efficient operation.

Of the nine turbine units now being installed, the I. P. Morris Co., of Philadelphia, Pa., designed and built six com-

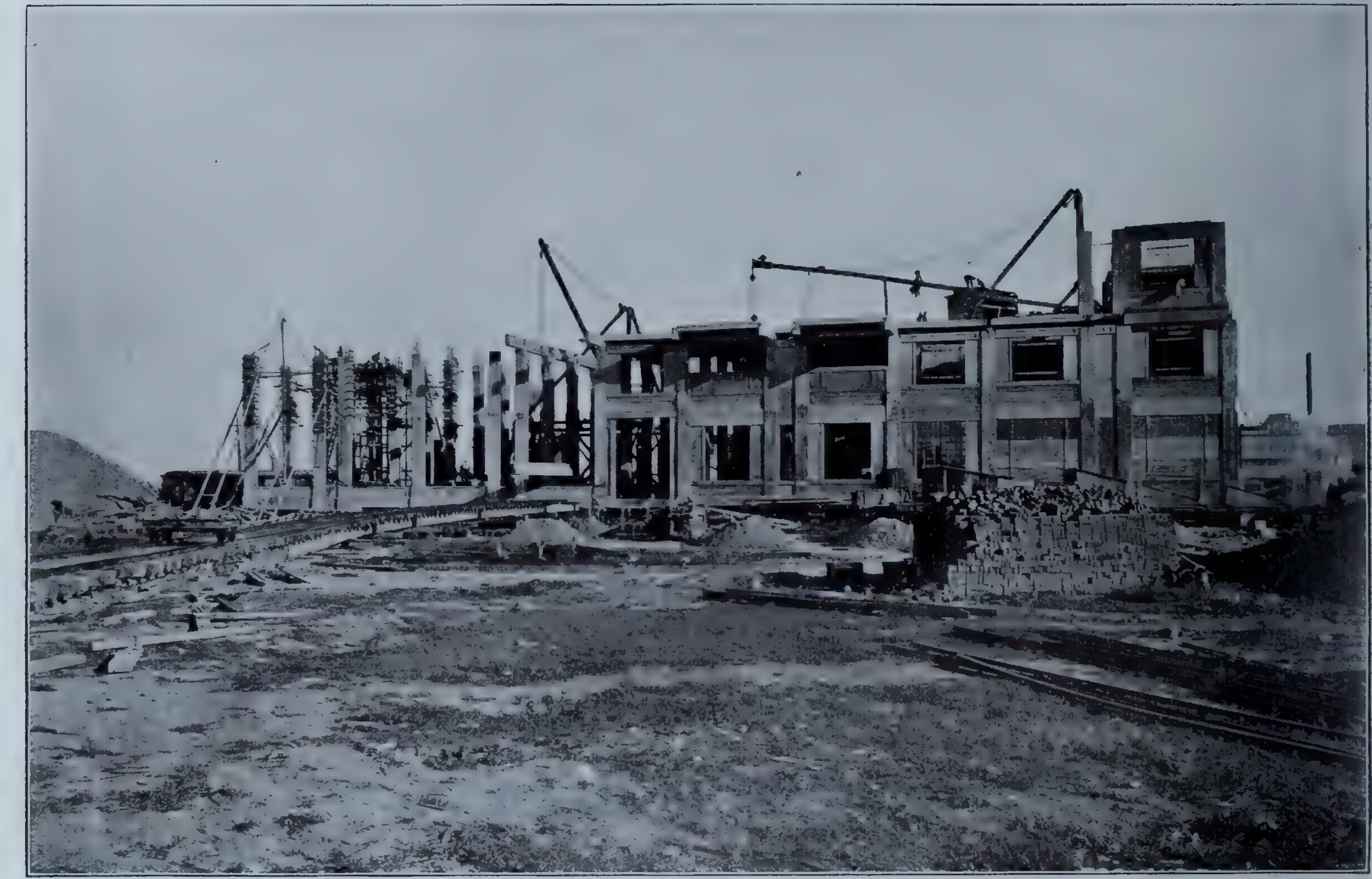


POWER HOUSE FROM CANAL SIDE, CEDARS RAPIDS MFG. & POWER CO.



POWER HOUSE, EAST (DOWN STREAM) SIDE, CEDARS RAPIDS MFG. & POWER CO.

plete, including the governor pumps and other auxiliary equipment, while the other three turbines were designed and built by the Wellman-Seaver-Morgan Co., of Cleveland, O. The generators were built by the General Electric Co., of Schenectady, N.Y., as also were the exciters, transformers, and other electrical equipment. On the head race side of the power house there are three openings for the water to enter each turbine, while on the tail race side there is but one opening, into which the draught tube discharges. The turbines are of the radial flow, central discharge type, having 16 buckets in each turbine.



TRANSFORMER HOUSE, CEDARS RAPIDS MFG. & POWER CO.

In addition to the main units, there are being installed six water driven exciter units. These units require 1,500 horse power to drive them, when operating at a speed of 150 r.p.m. The general design of these smaller units is similar to that of the larger ones.

The efforts of the engineers of the Cedars Company have been directed towards designing a simple and reliable plant. It is quite usual in vertical waterpower developments to place much of the auxiliary machinery such as governor pumps, thrust bearing pumps, thrust bearings and other pieces of apparatus (which, although auxiliary in a sense yet are vital to the proper operation of the plant), below the generator floor in tunnels or rooms. This arrangement although it tends to keep the main generator floor free and therefore improves in a sense the appearance, yet has a bad effect on the operation of the plant because such apparatus is not readily accessible in case of a breakdown, nor in such an emergency is the lightning too good generally. The attendants cannot, therefore, give the careful supervision to the auxiliaries which is so essential to the proper operation of the plant. If these machines are on the main floor of the power house they can be carefully looked after and the tendency for anything to go wrong be promptly observed. In the case of the Cedars Rapids power house a well directed effort has been made to put on the main floor such equipment as is at all vital to the continuity of operation of the main undertaking.

The Transformer House.

The transformer house is quite distinct from the power house as will be seen by reference to Fig. 1. It is located on the hill above the canal at a distance of about 300 feet from it. The transformer house is being constructed at the present time to take care of 100,000 horse power.. It is not expected that construction on this large power house will be completed much before the close of the present year.

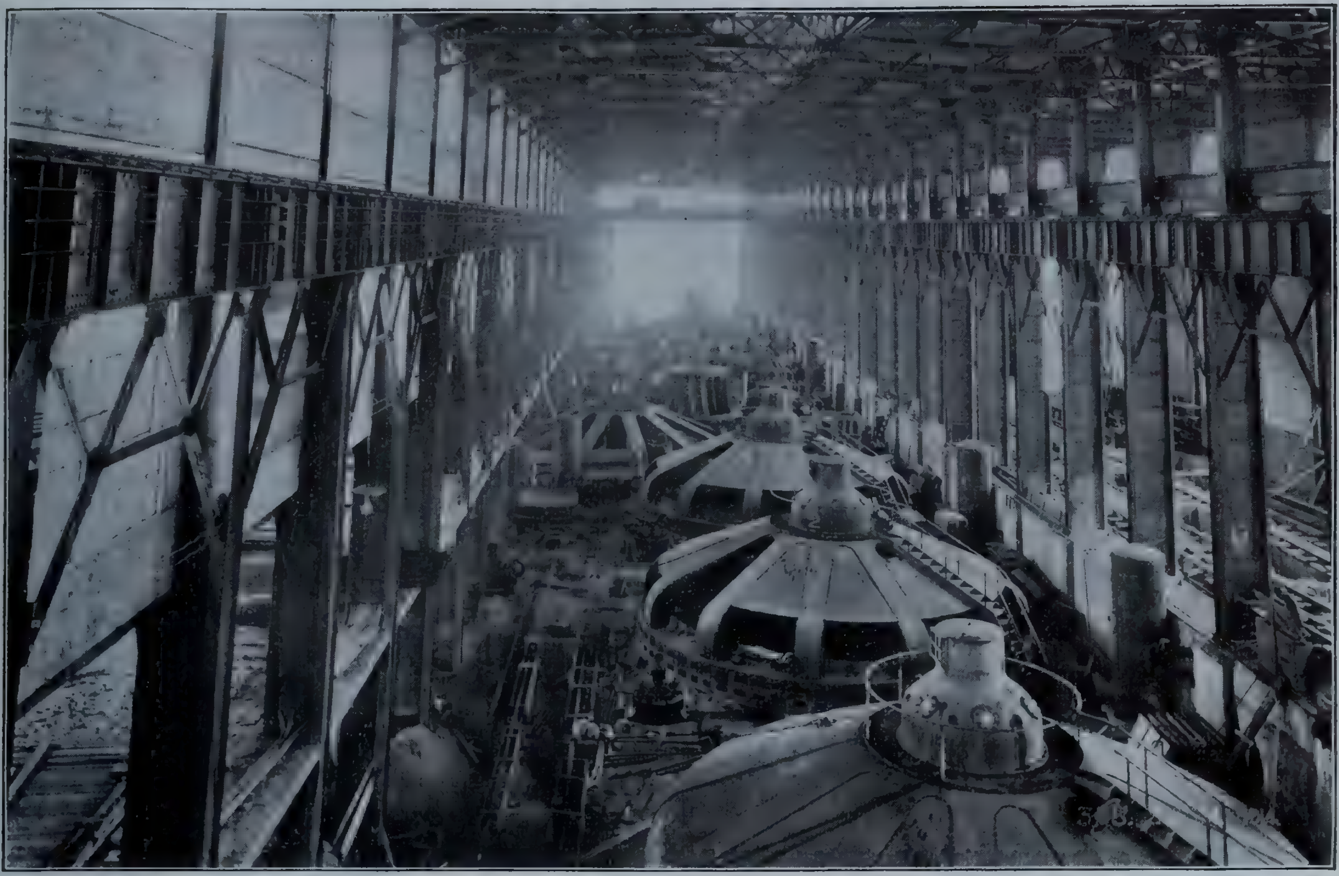
General.

The chief engineer of the company is Mr. Julian C. Smith, whose previous record in connection with the Shawinigan Power Co., is so well known. The commercial success of the undertaking is assured because contracts for large amounts of power have been secured from the Aluminum Co. of America and the Montreal Light, Heat, & Power Co. Because of these contracts, the construction of the power plant has been carried on vigorously. The concrete work will have all been completed before the advent of the frost, so that the more strictly interior finishing can be carried on without interruption until completed.

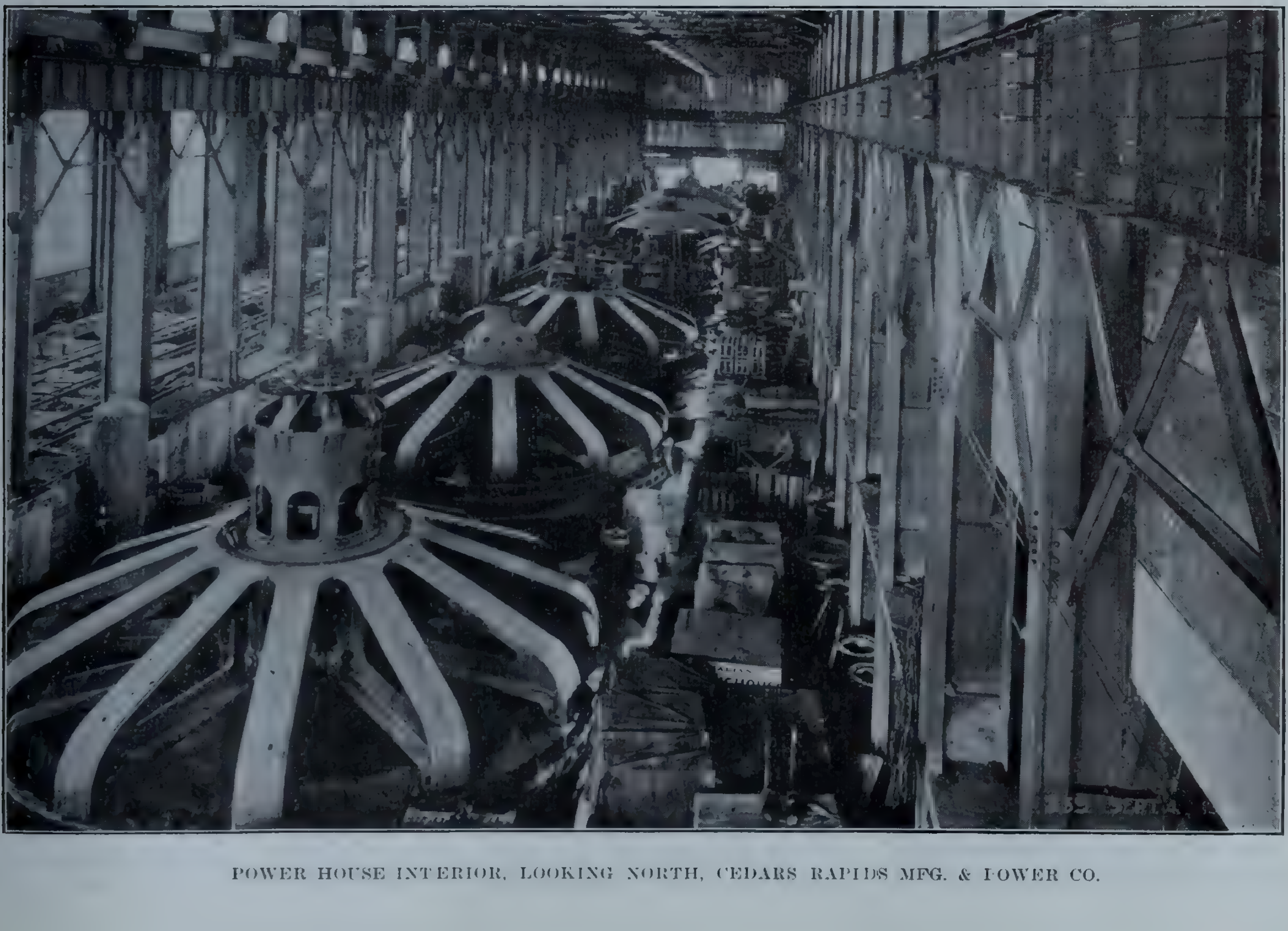
The Steam Boiler Branch of the Dept. of Public Works for the Province of Ontario, has registered 927 designs for boilers and fittings, up to date.

* * *

C.S.C.E. Officers.—An exceptionally largely attended meeting of the Ottawa Branch of the Canadian Society of Civil Engineers was held on October 8, in the Boardroom of the Commission of Conservation, when the following officers were elected for the ensuing year:—Chairman, A. St. Lambert; secretary-treasurer, A. B. Lambe; managing committee, W. J. Dick, R. deB. Corriveau, W. F. Cochrane, Alex. Bray and W. S. Lawson.



POWER HOUSE INTERIOR, LOOKING SOUTH, CEDARS RAPIDS MFG. & POWER CO.



POWER HOUSE INTERIOR, LOOKING NORTH, CEDARS RAPIDS MFG. & POWER CO.

Operators' Instruction Course

SERIAL LESSON VI.

IN the last number of this series the Bilgram valve diagram, in its simplest form, was explained at length. The application of all valve diagrams is modified by a number of conditions, such as angularity of the piston and eccentric rods, the manner of transmitting the motion from the eccentric to the valve stem, etc. The effect of all such considerations should be thought out before proceeding to obtain information by means of valve diagrams. The diagrams, as explained, apply to the plain slide valve and its simpler modifications. Its application to other valve gears will be explained as these are separately taken up.

Angularity of the Connecting Rod

The crank pin does not move back and forth in a straight line as does the piston and cross-head, but must swing round in a circle. For this reason the method of determining the crank pin position which has been given is correct only for such mechanisms as the slotted cross-head, Scotch yoke, and others in which the angularity of a connecting rod can have no effect. The swinging of the connecting rod from side to side, if the engine be running over, will cause cut off to occur **earlier** in the return stroke and **later** in the forward stroke, the piston being pulled forward in proportion to the amount of sideways motion of the crank pin.

If it be required to accurately find the relative positions of the crank and piston and thus the valve and piston, the effect of the connecting rod must be taken into account. This is done, as shown in Fig. 36, by means of the **arc** Cx instead of the straight line Cw, as in Fig. 34. The radius of this arc is equal to the length of the connecting rod to the same scale as the crank pin circle, and its centre is located on the base line extended towards the head end of the cylinder. The eccentric rod is usually very long in proportion to the valve travel, and, for this reason, the angularity of the eccentric rod has little effect on the valve, and can, therefore, in most cases be neglected.

Equalizing the Cut-off.

In order to have the cut-off occur at similar points in both forward and return strokes, various expedients are adopted. An examination of Fig. 37 will make it plain that if cut-off is to come about at similar points in the cylinder for both strokes, the crank pin positions will have to be different on account of both being drawn towards the cylinder. It is seen that one way of overcoming the effect of this shortening of the connecting rod would be to increase the lap for the head end and to decrease it for the crank end, as shown in Fig. 37. The drawback to this method is that the lead becomes excessive for the return stroke, as shown by the distance $(a_1\ q_1)$ as compared to (a q) which represents the lead for the forward stroke. The port opening is also unequal for all parts of the stroke, which is, however, not so important.

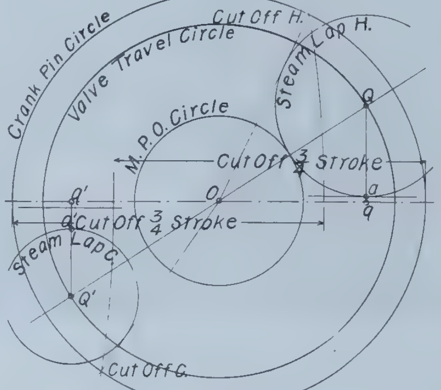


FIG. 37.—EFFECT OF ANGULARITY OF CONNECTING ROD.

A much better way of equalizing the cut-off is by means of a rocker arm, as shown in Fig. 38. The rocker arm, by creating similar irregularities in the valve motion serves to neutralize the effect of the connecting rod without disturbing the leads. Determine from the Bilgram diagram the travel, lap, angle of advance, etc., **for one end**, taking into account the effect of the connecting rod. Lay off the stroke, as at A H, and, upon it, the points where cut-off is to take place. On the same base line extended draw the crank pin circle C N and the valve travel circle (m n). Draw in the crank positions for cut-off—namely, C and N and for admission. Lay off the corresponding positions of the eccentric centre 90 degrees plus the angle of advance ahead of these. These are (n) and (m) for cut-off and (o) and (p) for admission.

We know that the valve is in the same position for both cut-off and admission—that is, for positions (o) and (n) and (p) and (m). Now, with the points (o) and (n) as centres, strike little arcs (o_1) and (n_1). Their intersection is the point at which the eccentric rod pin should be for admission and cut-off on the forward stroke. In the same way the point where the arcs (m_1) and (p_1) cross will be the same pin position for the return stroke. Connect these two points with a straight line and from its centre draw a perpendicular, as shown. This line will represent the central position of one arm of the rocker. The other arm V W should be perpendicular to the valve stem at the central position, and the point of intersection W must be chosen so as to make the two lever arms proportional to the throw of the eccentric and the travel of the valve respectively. In a similar way release or compression may be equalized.

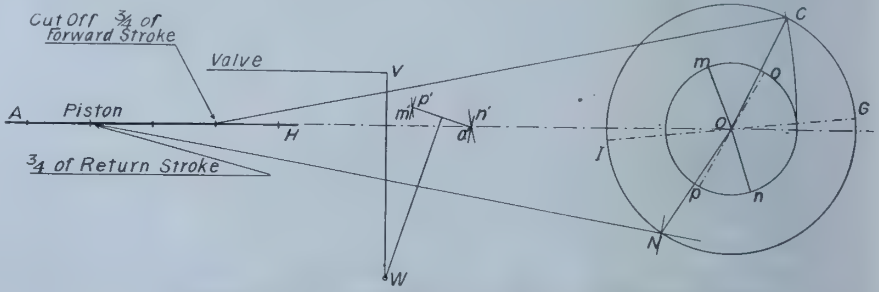


FIG. 38.—EQUALIZING CUT OFF BY MEANS OF ROCKER ARM

The equalization of the cut-off has more to do with the designing of the engine than with its operation; nevertheless a knowledge of the methods employed will be of great assistance in correcting troubles located by means of the steam engine indicator. Also, in attempting to obtain information by means of the Bilgram diagram care should be taken to find out previously whether means have been adopted to equalize the cut-off and other events of the stroke or not. It is well to observe also that where rocker arms are used, the throw of the eccentric is not necessarily the same as the valve displacement.

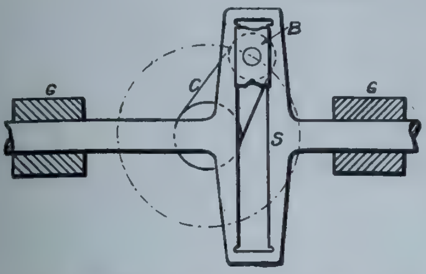


FIG. 39—SCOTCH YOKE OR SLOTTED CROSS HEAD IN WHICH THERE IS NO ANGULARITY OF CONNECTING ROD.

The Zeuner Diagram.

In a large number of shops in this country where the output of engines is not great, the setting of the eccentric is usually a cut-and-try process, and no diagram is used. When questioned concerning this practice the reason often given is that the purchaser sometimes has ideas of his own regarding amount of lap, lead, etc., and that no standard can be adopted. In the British Isles where the marine engines built are no doubt the best of their kind in the world, the valve gears are made to be assembled without any trial cuts so to speak, eccentric settings, laps and port widths being calculated beforehand by means of diagrams.

Among European engineers, the diagrams devised by Dr. Zeuner are most used and, for this reason, synopsis of their main features will be dealt with here. Many points of similarity will be found between the diagrams of Zeuner and Bilgram, and if either has been well understood by the student, no trouble should be experienced in mastering the salient points of the other.

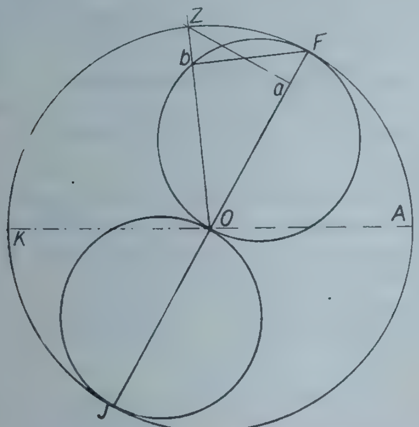


FIG. 40—DIAGRAM SHOWING PROOF OF ZEUNER'S THEORY.

The typical feature of the Zeuner diagram is that the value displacement is represented by the length of crank radius line intercepted by the valve 40, let J be the crank position and Z the circles. Referring to the diagram in Fig. eccentric position at any instant. The outer circle J A Z is the valve travel circle, the valve travel being represented by its diameter. The two smaller circles are termed valve circles and these are drawn with a diameter equal to half the valve travel or, in other words the eccentricity.

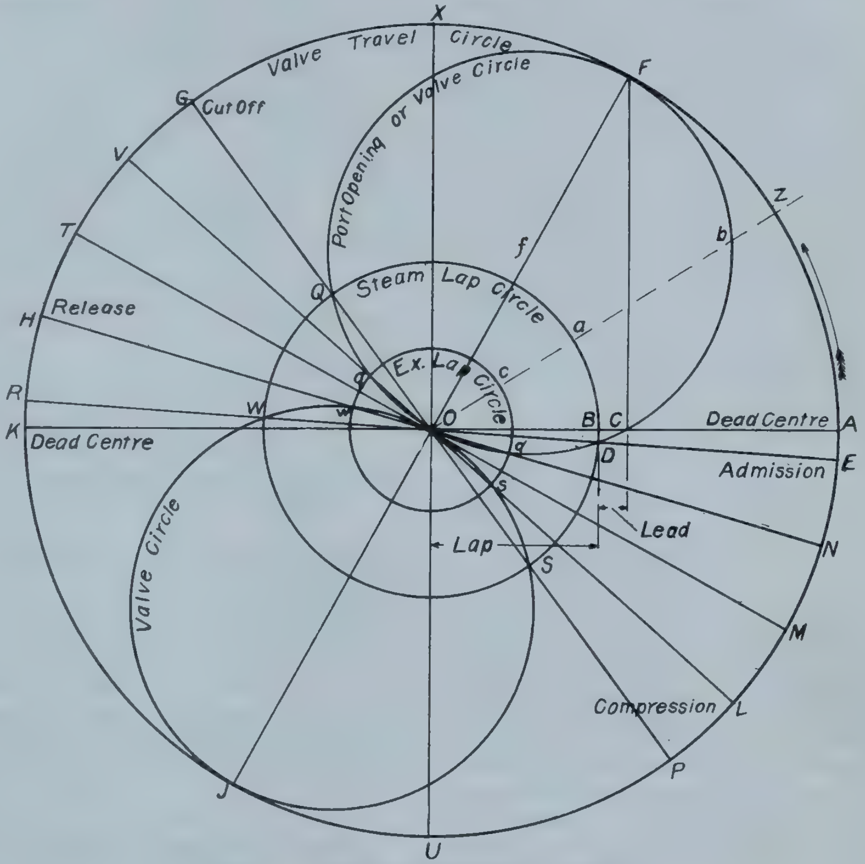


FIG. 41—COMPLETE ZEUNER DIAGRAM.

The part Ob of the eccentric radius which is intercepted by the valve circle ObF represents the valve displacement, that is, the amount the valve has moved from its central position. The reason for this is as follows:—We know that the valve displacement when the crank is at J and eccentric at Z is, Oa, a Z being a vertical line through Z on J F. It can be proved that, upon joining b F, the two triangles O b F and O a Z are equal in every respect, that is Ob = Oa or Ob, while the intercept of the eccentric radius by the valve circle represents the valve displacement for any position of the eccentric.

The diagram proper is shown in Fig. 41, and may be constructed in the following way: Describe a circle KXA with a diameter equal to the valve travel, and draw in the dead centre diameter KA. From O on the line KA measure off the lap OB and the lead BC. Through C draw a line at right angles to the dead centre line cutting the valve travel circle at the point F. Draw a diameter through the point F, namely F O J. Using the line O F as a diameter, describe the valve circle O F C and likewise on O J construct the valve circle W O J. With O as a centre, draw the steam lap circle W Q B and also the exhaust lap circle (w q c) with radii equal to the steam lap and exhaust lap respectively.

Where the valve circles intercept the steam lap circle, draw the crank diameters G P and R E. Also through the points where the exhaust lap circle cuts the valve circles, draw the diameters V L and H N. Through the centre O, midway between the two valve circles and at right angles to F J draw the crank diameter M T. For purposes of explanation draw any radius O Z of the valve travel circle.

Considering that the cylinder is to the right and the engine runs over, we will now locate the different points in the stroke at which the cylinder events occur. As before explained, the distance the valve has moved from its central position for any crank position is shown by the amount cut off the radius drawn through that point by the valve circle. At the point of admission, the displacement must equal the lap of the valve. The point of admission then, is at E because when the piston is at this point, the valve displacement or the part of the crank radius cut off by the valve circle is OD, which is equal to the radius of the steam lap circle and is, of course, the lap.

At the dead centre point A, the valve displacement is equal to O C or the lap O B plus the lead B C. When the crank reaches Z, the valve displacement is equal to Ob, therefore the port opening is (a b). At the point F the valve circle intercepts the whole radius O F which represents the eccentricity or the greatest valve displacement. The port opening is here equal to f F which is the greatest possible. The point F then, is the crank position for maximum port opening. As the crank pin moves around to G we find that the valve has moved back until the part intercepted by the valve circle is equal to O Q or the lap, and there is no port opening whatever. This point G is therefore the crank position for cut-off.

In the same way as with the steam lap circle, the part of the crank radius intercepted by the exhaust lap circle represents exhaust lap. At the point H, we find that the valve displacement is equal to Ow, which is the exhaust lap. That is, the port is about to open to exhaust. and H therefore is the crank position for release. This, it is seen, takes place slightly before the beginning of the return stroke just as admission takes place a little before the forward stroke. As the crank pin comes round on the return stroke, nothing particular happens until the point L is reached, when the valve displacement Os is again equal to the exhaust lap. The port is about to close to exhaust, and compression takes place. The cycle is completed as the crank returns to E the point of admission. At the points T and M, of course, the valve is in its central position and all ports are closed.

The time occupied in or the proportion of the stroke in which the crank pin is going from E to G is called the period of **admission.** That used in going from G to H is known as the period of **expansion.** From H to L is **exhaust** and from M to E is the period of **compression.** For certain purposes it is seen that this diagram is even more simple than that of Bilgram, and a little study will show that it can be used in the same way to obtain any desired information in connection with valves and gearing provided sufficient data are given.

To determine the correct piston position for any point in the stroke Dr. Zeuner used a supplementary diagram such as that shown in Fig. 42. The large circle A B R is drawn with a radius AO, representing the length of the connecting rod plus the length of the crank arm to some convenient scale. With a centre P and radius A P equal to the connecting rod, describe another circle A K touching the larger circle at A. With a centre O, the same as the large circle, describe the small circle P P which, of course, has a radius equal to the crank arm.

The lines AP and PO represent the connecting rod and crank arm respectively when the engine is on dead centre. Let pO be any other position of the crank and produce pO to B. It is easily seen that BK is equal to Aa, and therefore, for any position of the crank the distance the piston has moved from its starting position is equal to the intercept between these two circles of the crank line produced. The value of these diagrams depends largely upon their accuracy and, for this reason it is usually best to draw them to an enlarged scale.

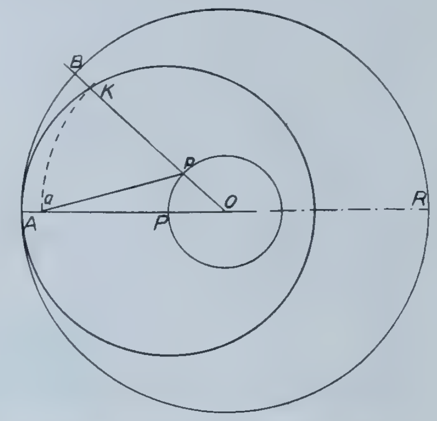


FIG. 42 AUXILIARY DIAGRAM FOR DETERMINING PISTON POSITION.

The next article of this series will deal with the steam engine indicator and indicator diagrams.

* * *

TRIPLE VERSUS COMPOUND ENGINES.

THE great economy resulting from the use of high-pressure steam is due to the fact that the increased pressure is obtained by the expenditure of an amount of fuel quite insignificant compared with the additional amount of energy it renders available. The following tabular statement makes this clear:

PRESSURES AND EFFICIENCIES.

Working Pressure in pounds per square inch.	Absolute Pressure in pounds per square inch.	Evaporation commences from	Evaporation effected at	Total Heat of Evaporation in Thermal Units per pound	Specific volume, cubic feet per pound	Total effective external work by one pound of Steam in ft. pounds.	Heat used per 100 ft. pounds of work done in Thermal units.	Saving of fuel at each step, per cent.
30	45	100° F.	274° F.	1098	9.26	126,256	8.696	....
75	90	100° F.	320° F.	1112	4.81	174,472	6.373	26.7
125	140	100° F.	353° F.	1122	3.17	206,994	5.420	14.9
175	190	100° F.	377° F.	1129	2.38	231,200	4.833	10.8
225	240	100° F.	397° F.	1135	1.91	255,000	4.425	8.4

An engine using steam of 125 pounds pressure should, other things being equal, consume nearly 15 per cent. less fuel than one using steam of 75 pounds pressure, and one using steam of 175 pounds pressure should effect a further saving of nearly 11 per cent.; therefore, by using steam of 175 pounds in place of 75 pounds, a saving of over 23 per cent. should result.

In practice, however, it is found that a compound engine using steam of 140 pounds pressure shows very little economy over a similar engine using 90 pounds steam; while a triple engine using 140 pounds steam shows even a greater economy than is theoretically due to the increased pressure, owing, no doubt, chiefly to the diminished range of temperature in each cylinder.

The actual amount of fuel saved by using a modern triple expansion engine, working at 160 pounds pressure, as compared with a compound engine using, say, 75 pounds steam, is nearly 25 per cent.

When the average magnitude of the strains set up in the two types of engine are compared, the result is again greatly in favor of the triple. The average strain on the rods, columns, guides, etc., is 50 per cent. more with the compound than with the triple engine. The latter is better balanced than the former, works with less vibration, gives a more equable turning moment, and consequently a higher transmission efficiency.—Seaton.

* * *

F. W. Moneur, sales manager of the Canadian Tungsten Lamp Co., Ltd., of Hamilton, Ont., has resigned his position.

Hon. I. B. Lucas has been appointed as the representative of the Ontario Government upon the Hydro-Electric Commission.

R. O. Wynne Roberts, consulting engineer, Regina, Sask., was recently in Toronto. He will also visit Montreal and New York.

R. D. S. Beckstedt has been appointed superintendent of the Tagona Water & Light Co., Sault Ste. Marie, succeeding R. A. Campbell.

Question and Answer Series

Question.—Wanted for actual tests, the comparative horse power for driving both high and low-speed blowers of the same capacity, the blowers to be used for collecting shavings in a planning mill.

Answer.—With the same blast areas, high and low-speed blowers of the same capacity will require the same horse-power. Low-speed blowers generally have larger blast areas and consequently larger exhaust pipes. This avoids the back pressure, in a small exhaust pipe, which is one of the chief causes of increased horse-power.

* * *

Question.—With an elevator of one-ton capacity and a total distance to be lifted of 150 feet, which would be the more economical to operate, an elevator to be lifted the 150 feet in one minute, or one to be lifted the 150 feet in two minutes? The motor would, of course, have to be larger for the one minute work, but it would need to be used only half as long.

Answer.—The amount of current per car mile for a one-ton elevator would be about the same at 75 feet and 150 feet per minute, which are moderate speeds. If higher speed were used, the consumption per car mile would be materially increased. Like other apparatus, there is an efficient speed for which the elevator is designed to operate; an increased speed will require power to overcome the increased inertia and decreased speed will waste power in added gear reduction.

* * *

Question.—A steel stack is 50 feet high, and is mounted on a base 10 ft. high. Twenty feet from the top is a ring, to which are fastened four guy cables. If these be attached to the ground 45 ft. from the base, how many feet of cable will be required?

Answer.—The height of the ring to which the guy ropes are attached above the ground is $50+10-20=40$ ft. The length of one cable is $\sqrt{(40^2+45^2)} = \sqrt{3625} = 60.24$ ft. Four cables would require $60{:}24\times4 = 240.96$ ft.

* * *

Question.—An ash hopper is shaped like an inverted pyramid. The length of one side of the top is 12 ft. and its height is 14 ft. How many square feet of steel plate will be required, and how many cubic feet of ashes will it contain when filled to within two feet of the top?

Answer.—To find the area of a triangle, multiply the base by half the height. The base, in this case, is 12 ft. and the height is the hypotenuse of a triangle, whose height is 14 ft., and whose base is 6 ft. The height then is $\sqrt{(6^2+14^2)} = 15.23$ ft.

Area of one side is $\frac{12\times15.23}{2}$. Area of four sides is $\frac{12\times15.23\times4}{2} = 365.52$ sq. ft.

The volume of the hopper is the area of the base multiplied by one-third the height, and the length of a side of the base two feet from the top is a case of proportion, or is $\frac{12\times12}{14} = 10.28$ ft.

Area of base $= 10.28\times10.28 = 105.67$, and volume of ashes contained is $\frac{105.67\times12}{3} = 422.71$ cubic feet.

* * *

Question.—What would be the cooling surface of a surface condenser having 7,020 tubes, each 0.75 in. in diameter and 14 ft. long? Allowing 3.5 sq. ft. of cooling surface per kilowatt, what capacity generator could be served by this condenser?

Answer.—Circumference of one tube is $0.75\times3.1416=2.36$ in. Surface of one tube$=14\times12\times2.36=396.48$ sq. in$=2.75$ sq. ft.

Surface of 7,020 such tubes is $70.20\times2.75 = 19{,}305$ sq. ft. Capacity $= \frac{19305}{3.5} = 5515.6$ kw.

* * *

Question.—In the above problem, at a steam consumption of 12.8 lb. per kilowatt-hour for the turbine, how many pounds of steam would the condenser handle per hour?

Answer.—$5515.6\times12.8=70{,}599.68$ lb.

* * *

Question.—What would be the radiation loss in B.t.u per year from a steam pipe 6 in. in diameter and 40 ft. long under 150 lb. steam pressure?

Answer — Experiments have shown that the radiation loss of steam pipes is 3 B.t.u. per hour for each degree difference in temperature between the pipe and surrounding air. Taking the average temperature of the air at 80 deg. F., and considering that the plant runs 24 hours per day for 300 days, and assuming outside diameter of pipe to be 6⅜ in., surface of pipe$=\frac{6.375\times3.1416\times40}{12}$ $=66{,}759$ sq. ft.

Temperature of steam at 150 lb.$=366.5$ deg. F.

Difference between temperature of steam and air is $366.5-80=286.5$ deg.

Loss per year$=286.5\times66.759\times300\times24$ $=137{,}714{,}328$ B.t.u., or the total heating value of $\frac{137{,}714{,}328}{14{,}000} = 9{,}837.45$ pounds, or about 5 tons of coal.

* * *

Question.—How many gallons of gasoline could be stored in a bumped head cylindrical tank 6 ft. 8 in. long, with an additional spherical rise of 4 in. in each head and an inside diameter of 3ft. 6in.?

Answer.—Volume of the cylindrical part is $42\times42\times.7854\times80 = 110{,}835.65$ cubic inches.

To find the volume of a spherical segment, add three times the square of the radius of the base to the square of the height. Multiply the sum by the height and by 0.5236.

The volume of the two spherical ends is, therefore,

$[(21^2\times3)+(4^2)]\times4\times0.5236\times2=5608.8$ cubic inches.

Volume of tank$=110{,}835.65 + 5608.8$ $=116{,}444.45$ cu. in., or $\frac{116{,}444.45}{277{,}274}$ $= 419.96$ gals.

* * *

Question.—A flywheel has an outer diameter of 124 in., the rim thickness is 5 in., and its width is 16 in. What would be the weight of the rim? If it were discovered to be 2¾ pounds out of balance, how many 1½-inch holes, 1½-in. deep, would have to be drilled in the heavy side to bring it right?

Answer.—Mean diameter=119 in. Volume $= 5\times16\times119\times3.1416=29{,}907.032$ cubic inches.

Weight $= 29908.032\times0.26 = 7776.088$ pounds.

Volume of one hole$=1.5^2\times7854\times1.5 =2.05$ cu. in.

No. of cu. ins. required to make 2.75 pounds $= \frac{2.75}{.26} = 10.57$

No. of holes required$= \frac{10.57}{2.05} = 5.15$

* * *

Question.—A 75-ton hydraulic press is supported by four 2-inch round steel bars. What is the unit stress in the bars when the machine is working to capacity?

Answer.—Area of cross-section of a 2-inch round bar is $2^2 \times .7854 = 3.1416$ sq. in. Total area of four bars is $3{,}1416 \times 4 = 12.5664$ sq. ins. Total load distributed over this area is $75 \times 2{,}000 = 150{,}000$ lbs., or stress per sq. in. in bars $= \frac{150{,}000}{12.5664} = 11936.6$ lbs.

* * *

Question.—If the allowable working stress in piston rods is 8,000 lbs. per sq. in., what should be the size of the rod for a 24-inch piston with a maximum steam pressure of 120 lbs. per sq. in.?

Answer.—Area of piston $= 24 \times 24 \times .7854 = 452.389$ sq. in. Total possible load is $452.389 \times 120 = 54{,}286.68$ lbs. Number of sq. ins. required is $\frac{54286.68}{8000} = 6.785$ sq. in. This would be furnished by a shaft $= \sqrt{\frac{6.785}{.7854}} = 2.94$ in dia., or say a 3-inch shaft.

* * *

Question.—The maximum thrust on a piston rod of an engine is 62,000 pounds. If the working strength of steel subjected to shearing under these conditions is 6,000 lb. per sq. in., what size crank pin would be required?

Answer—Shearing strength depends upon the cross sectional area to be sheared off in case of failure. Amount of material necessary is $\frac{62{,}000}{6{,}000} = 10.33$ sq. in. The diameter of a pin necessary to give 10,333 sq. inches would be $\sqrt{\frac{10.333}{.7854.}} = 3.62$ in., say 3⅛ inches.

* * *

Question—Skill in design consists largely in making all the parts of a mechanism equally strong. How thick should the head of a 2-inch bolt be in order that the resistance to stripping the head off be equal to the tensile strength of the bolt?

Answer—For a steel bolt consider tensile strength equal to 60,000 lbs. per sq. in. and shearing strength to be 48,000 lbs. per sq. in. The total tensile load a 2-inch bolt would stand $= 2^2 \times .7854 \times 60{,}000 = 188{,}496$ lbs. The shearing strength of the head must equal this. The necessary shearing area will be $\frac{188{,}496}{48{,}000} = 3.927$ sq. in. One dimension of this area is the circumference of the bolt, which is $2 \times 3.1416 = 6.2832$ in. Necessary thickness of bolt head then is $3.927 \div 6.2832 = .624$ in.

* * *

Question—A piston rod is subjected to a pull of 30,000 lbs. What should be the dimensions of a cross-head key one inch thick?

Answer—This key would be in double shear, therefore the length of the shearing surface would be 2 inches. Using a working stress of 6,000 lbs. per sq. in., a shearing area of $\frac{30{,}000}{6{,}000} = 5$ sq. in. would be required. The depth of the required key, then, would be $\frac{5}{2} = 2.5$ inches.

* * *

Question—The cast iron cylinder of a hydraulic press is 10-inch bore and is subjected to a pressure of 5,000 lbs. per sq. in. How thick should the metal be?

Answer—Consider a section of the length 1 inch long. The pressure tending to separate it into two halves is $1 \times 10 \times 5000 = 50{,}000$ pounds, which is 25,000 lbs. on each side. Working strength of cast iron under these conditions is 3,000 lbs. per sq. in. As a section 1 inch long is subjected to 25,000 lbs., the necessary thickness would be $\frac{25{,}000}{3{,}000} = 8.33$ inches.

* * *

Question.—In a hydraulic plunger elevator system with lift 165 feet, and operated by electric-driven centrifugal pumps, will the power consumption for a given travel be greater when the system is operated at 175 than at 160 lb. pressure? Assuming that the consumption is greater in the former case, as seems correct, what becomes of the extra power required when operating at the higher pressure, the travel and ultimate work accomplished in either case being the same?

Answer.—Hydraulic elevators operated by electrically-driven centrifugal or triplex pumps require the use of a storage tank in which the air is the cushioning medium. If the pressure of the system were 160 lb., the pressure of the compressed air in the receiving tank would be 160 lb. Should this be compressed at 175 lb. instead of 160 lb., more heat would be generated in the compression and therefore the radiation of heat would be greater than at 160 lb. pressure. Assuming the efficiency of the pumps at the two pressures to be the same, the only difference in the current consumption would be the extra heat unit lost in compressing to a higher pressure. However, other losses such as efficiency of apparatus, friction, etc., might affect the current consumption, the difference in current consumption depending on the physical design of the apparatus in question.

* * *

Question.—Making no allowances for losses, in what time will a standpipe be filled by a duplex pump having 30-in. plungers, 34-in. stroke, and making 20 strokes per minute? The standpipe is 125 feet high, and contains 198,804 gallons.

Answer.—One Imperial gallon contains 277,274 cu. in. The volume of the standpipe is $198{,}804\times277.274$ cu. in.

Amount of water pumped at each stroke is $15^2\times3.1416\times34\times2.$ Amount pumped per minute

$=15\times15\times3.1416\times34\times2\times20$

Time required to fill the tank is

$$\frac{198804\times277{,}274}{15\times15\times3.1416\times34\times2\times20} = 57.31 \text{ mins.}$$

* * *

Question.—How many yards of concrete would be required for an engine foundation, the sides of which slope up like a frustrum of a pyramid? The base is 31×12 ft., the top is 26×9 ft., and the height is 11 ft.

Answer.—To find the volume of a frustrum of a pyramid or cone, add together the areas of both bases and the square root of their product. Multiply the sum by one-third the height.

Area of base$=31\times12=372$ sq. ft.

Area of top surface$=26\times9=234$ sq. ft.

$$\sqrt{(372\times234)}=295$$

$$\text{Volume} = \frac{(372+234+295)\times11}{3}$$

$$=3303.66 \text{ cu. ft.}$$

$$= \frac{3303.66}{27} = 122.358 \text{ yards.}$$

* * *

C G.E. Service Corps.—A notable contribution to the service of the Empire has been made by the Canadian General Electric Co. By drawing on its technical staff, it has raised a corps of engineers, both electrical and mechanical, for service during the war, and has further undertaken the duty of maintaining the corps for that period.

The Operators' Point of View

A READER'S APPRECIATION.

By J. S. Drysdale.

I READ **The Power House** with interest every month, and like many others, I get some very useful ideas, which I always put into practice at the very first opportunity. I have put to the test the various hints and found them of good service, and feel that I should pass on my experiences to others; for although some may have tried them on their own account, and, like myself, have found them all right, numbers may never have thought of them. The accompanying kinks may be useful to my fellow-craftsmen.

Grinding Pump Valves.

Not long ago I had a small steam pump to repair, and as the valves were all in bad shape, I started to grind them, but found that the flour of emery was too coarse and was scratching the valve faces. As I could not get any finer emery in the factory, I hardly knew how I was going to get through with the grinding job; so when home for lunch, I took some Dutch cleanser back with me, with the idea of seeing how it would work on the brass, which, by the way, was very soft. In a very short time, it is my pleasure to state, I had the eight valves ground up in good shape and without a scratch.

Hammer Heads Loosening.

I have often found trouble with hammer heads getting loose through the wedges coming out, and to overcome this I use a small steel burr or washer with a knife edge ground on it, and driven into the handle. On large hammers I use two washers. When the washer is driven into the wood handle it is there to stay, for as soon as it goes in, the wood closes into the hole of the washer, so that it cannot come out.

* * *

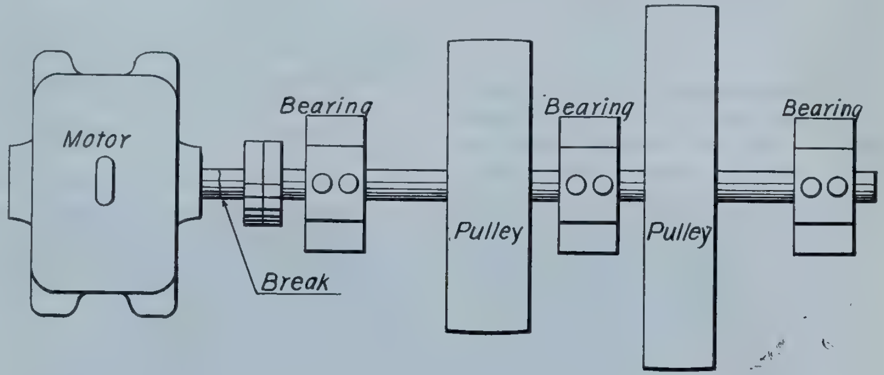
A SHAFT FAILURE WITH A REASON.

By H. Womersley.

IT is often difficult to place the responsibility for the non-success of new machines, and the millwright will often do well to go cautiously when prompted to place the blame for the non-realization of expectations upon the machine or its builders. On the other hand, the maker's reputation will be safeguarded by his assuming the responsibility of putting the machine into successful operation as well as manufacturing it.

The writer's firm recently furnished an electric alternating current motor to a small manufacturer for the purpose of driving a head shaft. The motor was fitted with ball bearings, and, before leaving the works, was tested out at full load for six hours and at 25 per cent. over-load for one hour. It was set in place by the customer himself, the connection to the head shaft being by means of a coupling, as shown by the illustration.

The machine had scarcely been running two hours when we received a telephone message saying that the rotor shaft had twisted in two. After directing that everything be left in position, the writer hastened to the scene of the trouble and found upon his arrival that the report was substantially correct.



MOTOR AND HEAD SHAFT SETTING.

The shaft had been twisted off close to the coupling. The head shaft had been supported by two end bearings, as shown, and, upon our advice, an additional bearing was placed near the centre between the pulleys. A new rotor shaft was supplied; the broken shaft was replaced, and the machine has now been in successful operation for about five months.

In this connection a few practical hints on and facts in connection with shafting might be of interest. A revolving shaft having the power applied at one end always twists somewhat throughout its length. In other words, the end to which the power is applied moves slightly in advance of the other end where the work is done. The amount of twist varies directly as the length, directly as the moment of the load, inversely as the rigidity of the material of which the shaft is made, and inversely as the fourth power of the diameter. These laws hold good so long as the material is not stressed beyond the elastic limit.

The transverse strength or resistance to bending is directly proportional to the cube of the diameter and inversely proportional to the distance between supports. The transverse stiffness which determines the deflection is directly proportional to the fourth power of the diameter, and is inversely proportional to the load and to the cube of the distance between supports. The following formulae will be found practical, simple and good for quickly estimating the horse-power that can be transmitted by mild steel shafting:—

For head shafts which are well supported, multiply the cube of the diameter by the revolutions per minute and divide the product by the constant 100. For line shafts well supported use the constant 66 2/3, and for transmission shafts apply the constant 50.

It is an axiom among millwrights that turned shafting, when properly made, is more desirable than cold rolled. The process of manufacturing the latter produces an initial crystallization in the surface and incidentally a soft centre. While it is maintained that the elastic strength and the shock-resisting power of the material is increased, it should be borne in mind that its natural condition is of a soft nature so that the load must be carried mostly by the outer skin or stiffer part of the shaft. When the surface is broken for the purpose of placing keyseats the ensuing spring introduces all the difficulties of shaft straightening. Shafts turned from hot rolled mild steel bars, straightened before being turned, and well finished and polished, will give the strongest combination of stiffness, true running and minimum loss of power.

DOES THE STATIONARY ENGINEERING PROFESSION PAY?

By. W. B. Henry.

IN the August issue of **The Power House**, T. W. Armour makes some statements on the subject of the stationary engineering profession to which I wish to add a few others.

Stationary engineering does pay, and pays well, and the only reason why there are those who dispute the fact is that they have not made good and hence are only worth what they are getting and not what they believe they should get. The price a man receives for his services is a simple business deal of buyer and seller.

An employer needs an engineer and in his own mind has an idea what type and quality of man he wants; he also knows about what he will pay. An applicant comes to him and says that he is an engineer, etc. He, too, has an idea of what he should receive in cash for his services.

Just here a great many of us get in wrong, for we have a greater price placed on our services than these are worth; consequently we do not make a sale or, if we do, it is because we accept the price offered. I have known many men who placed very high value on their ability; they worked, however, for what they could get, and complained all the while that there was no money in the job. Numbers of them are still hanging on.

Now, why do they stick to it? The answer is a simple one. They get a good deal more out of it than they put in, and much more than they would receive for an equal effort in any other kind of job.

No manufacturing plant is operated as a charitable institution; it is run for profit, and must be profitable, hence the manager considering the men as an investment, must realize on it, otherwise there is a loss. We, ourselves, if we employ a man to build a chicken house, want a fair day's work in return for the money we pay, and when the day is done we realize whether or not we are satisfied with what we have received. A manager in charge of hundreds of men is in exactly the same position, he must have value for the price he pays.

It is my privilege to state that I have in fifteen years only met with one manager who would not pay for honest service rendered, and in that case I do not blame him directly, because when a man changes from an insurance agent to manager of a joint stock company, operating a manufacturing plant, and steps in to operate the plant, some very strange stunts are liable to be pulled off. This is the only case I have met of services rendered not being appreciated. To prove that services rendered are appreciated and paid for I will state a few cases:—

A small factory paid $65 per month to a man with "certificate" who growled because he got so little. The manager said, "I paid him to hang up that certificate to fulfill the law. He rendered no services at all except start and stop the engine, and could not explain why of anything, or much less attempt to cut our high coal bill. This same job paid $25 per week of 55 hours in summer and 60 hours in winter, to a man who was a real engineer, and made good.

Another similar shop paid $16 per week to a man who claimed to be an engineer. The engine was overloaded and an order was already placed for a new and larger unit to cost f.o.b. the builders' works some $3,300. A new man, an engineer was employed and, as a result of knowing his business, that overloaded engine became quite large enough for the work and the shipment of the new engine was held up; the purchaser offering it for sale. This $16 a week job paid $20 per week to the man who made good.

Another plant with a 150 horse power boiler using shavings only for fuel, and a Corliss engine, was operated by two men, an engineer and a fireman. A good live engineer came along who tuned up the plant, with the result that the engineer did the whole job, and had a good time too. In addition he received $5 per week more pay. These three plants were each under 200 horse power capacity.

Of the larger plants, I am personally acquainted with several men who make from $150 per month and up, and know of one man who makes $10 per day as a stationary engineer.. It should, therefore, be clear to all that **Stationary Engineering Pays!** If it does not pay, look at home for the trouble. The world is wide, experience is got every hour of the day and education is brought to your very door by one means or another. **The Power House** is a college in itself.

If you don't get the money, then either improve the quality of the goods you have to offer, or find out why the quality of the goods does not appeal more convincingly to those who pay the price you want.

If you don't get the money there is a reason; find the reason, and the means by which to get the pay you desire should be clear as daylight. If you have the goods of the genuine quality you can not fail to get the price.

It matters not whether you buy groceries, dry goods or labor; you want value for your money; so does the manager. If you honestly have given him value and he won't pay, there is some one else who will.

WHAT BE EFFICIENCY?

By J. Ellethorn.

"SAY, boss," said Mike the fireman to the engineer, "what do this thing **efficiency** in the power plant be that I do be hearing a lot of talk about?" "Well," said the engineer, "**efficiency** in the power plant means lots of things, and it all depends on who you are and what you want it to mean."

"The agent for Buncums boiler compound will tell you that most fuel is wasted because of scale which no compound will remove like Buncums. The CO_2 recorder man will surely convince you that without his recorder economy is impossible, and the next fellow will try and convince you that the CO_2 outfit is practically useless unless you use his scientifically perfect draft recorder along with it. The combustion expert is positive in asserting that the whole fault lies in improperly constructed furnaces, while the engine builder's agent is just as certain that it is absolutely impossible to secure efficiency unless you use his nearly perfect engine.

"According to what we are told, power plant efficiency is impossible without all of the foregoing, and with the addition of patent furnaces, shaking, dumping, traveling and other kinds of grates, automatic stokers, coal weighers, smoke testers, recording gauges, and about five hundred other devices which may all be good things under proper conditions; but, Mike, the owners of a power plant may have every up-to-date and ahead-of-date article or apparatus manufactured to save steam, water or fuel, to reduce friction and save oil, to work automatically and reduce labor, and still fail to get efficiency or economy."

"Well, well, for heaven's sake, boss, what can a fellow do, or is efficiency an impossibility entirely?"

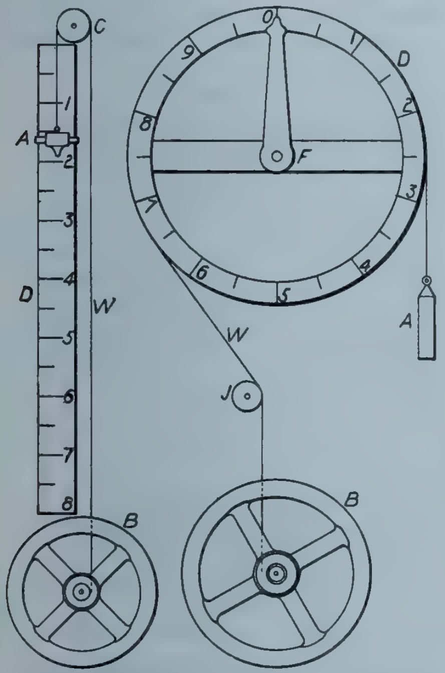
"Listen, Mike. efficiency is quite possible and quite easy. The first requisite is a capable engineer who knows his business and who means business. The second and about as important is an intelligent fireman, or set of firemen, who do not depend on automatic machinery, no matter how perfect, to do their thinking; firemen, to be sure, who know about as much as the engineer, and who get nearly as good wages; firemen, in fact, altogether different from you, Mike, men who know what efficiency means, and who must needs be paid for knowing it. However, as things are, I will have to use you, and men like you, at the expense of efficiency."

* * *

INDICATOR FOR AMOUNT OF VALVE OPENING.

By J. E. Noble.

IN many situations it is often necessary to be able to tell at any time, the number of turns a steam, air or water valve has been opened. A simple device for this purpose, was made up and put into service by the Western Gas Association and has given good results particularly where the valve was required to be used as a regulator of the gas flow. In the writer's opinion, it could be used to advantage in a great many shops and power plants.



INDICATORS FOR VALVE OPENING.

In the left hand part of the figure, B is the valve wheel and A is a small grooved pulley. One end of the cord W is fastened to the valve spindle while the other passes over the sheave C and is attached to the small pointed lead weight A. A scale D which may be supported in any convenient way or place is graduated so that each division represents one turn of the valve wheel. The position of the weight A in relation to the lines on the scale shows at a glance the setting of the valve.

The right hand part of the figure illustrates the same principle applied to another form of scale. The pointer F is stationary while the scale itself forms the sheave and revolves, the cord being kept tight by the weight A. This form is most useful in cases where the full opening requires a great many turns.

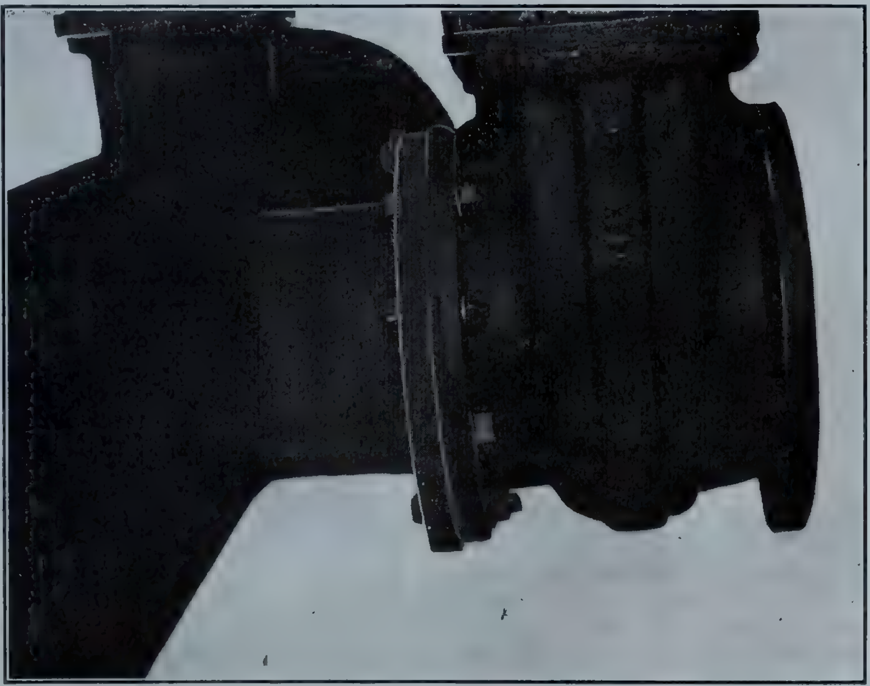
* * *

EXHAUST HEADER WITH WELDED NOZZLES.

By F. K. Blair.

THE illustration shows an 18-in. exhaust header in the plant of the London Electric Co.,London, Ont., to which has been welded a 10-in. and 12-in. nozzle, the former being the exhaust connection from three high-speed engines, and the latter a connection to one of three condensers. In addition to the nozzles shown, which, by the way, came quite close to each other and at right angles according to the layout, numerous other 10-in. and 12-in. connections were made by welding, none of them, of course, being on piping subject to high internal pressure.

The particular advantage derived from having the nozzles welded was that of getting connections close together where these were desirable, without the complications of crowded-up fittings and a multiplicity of joints. Perfect satisfaction of service is being rendered by the various joints, a circumstance more or less complimentary to Green & Sloan, Bredalbane street, Toronto, who carried out the work.



EXHAUST HEADER WITH WELDED NOZZLES.

* * *

EFFICIENT HEATING AND TRANSMISSION ARRANGEMENT.

By J. Thorn.

IN reading the article by H. W. Benton on page 277, September issue of **The Power House**, one is struck with the wonderful saving of coal accomplished. In fact, the statement that the coal consumption was reduced from 183 to 55 tons per month, a monthly saving of 128 tons almost takes the breath away. At $4.50 per ton this represents an annual saving of $6,932 in coal alone. This is surely a record for a small plant, and, even if the plant were in exceptionally bad shape to start with, it reflects very much credit on the engineer

About $17,000 worth of coal is used annually by the plant where the writer is employed. By making changes and careful operating, the fuel cost was reduced by about $1,300 per annum, and the staff considered that there was cause for more or less self satisfaction, but the accomplishments of Mr. Benton have taken much of the conceit out of us. The main reason for the failure of the coils described by Mr. Benton is doubtless the smallness of the return or drips. Possibly the fault lay in the bucket traps being too small. Of course the bottom coil should have been connected to

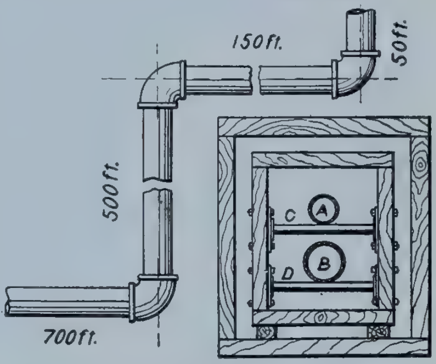


FIG. 1. MAIN PIPE LINE.
FIG. 2. ENCLOSURE FOR STEAM MAINS.

the steam main and the bucket traps should have had a 2-in. or larger inlet and outlet. The writer has found D. G. C. regulating valves to be every bit as good and much cheaper than the traps spoken of by Mr. Benton and, although not shown in Fig. 3, would be much better than the valves shown even if more expensive.

A heating plant was installed by the writer in the carpenter and pattern shops of the Canadian General Electric Co. about 14 years ago somewhat similar to the one described by Mr. Benton. It worked perfectly for a number of years and may still be in successful operation. Its principal feature consists of successful long heat transmission. The main and returns were run from the power house to the shops, a distance of 1,400 feet and about 10,000 feet of one-inch pipe was used in the radiation coils. The run of the mains is shown in Fig. 1. Two expansion joints securely anchored were used in the 500 ft. run and two in the 700 foot pipe line. The method adopted to support the pipes to allow for expansion and contraction is shown in Fig. 2. The pipes are represented by A and B, while C and D are short pieces of 1½ inch pipe, which are held in place by loosely fitting flanges. This allows free movement for expansion and contraction.

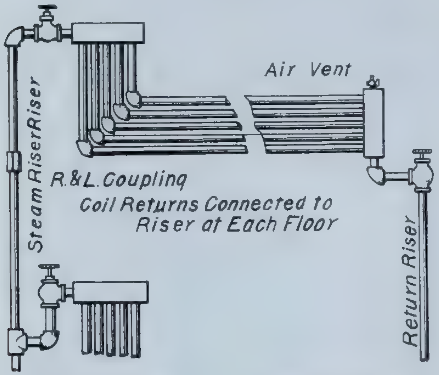


FIG. 3. WALL COIL CONNECTIONS.

The double wood protection was made of 2-inch planks and care was taken to make them water-tight by packing all joints and coating both with a good preservative. The result was remarkable in that the radiation loss in this pipe-line was exceeedingly small and, when the plant was running at full capacity, almost negligible in zero weather.

The steam main is 4 inch and the return 2½ inch pipe. The condensation returns by gravity to a closed tank in the power house, from which it is automatically pumped through the separator to the boiler by a small duplex pump. The method of connecting the coils is shown in Fig. 3, which is the same, in theory, as that described by Mr. Benton. All-pipe steam wall coils were never troubled with poor circulation in spite of the long main and the back pressure on the engine never exceeded five pounds. A by-pass valve was arranged to let live steam into the mains when the engine was idle. The whole system proved to be economical, efficient and noiseless.

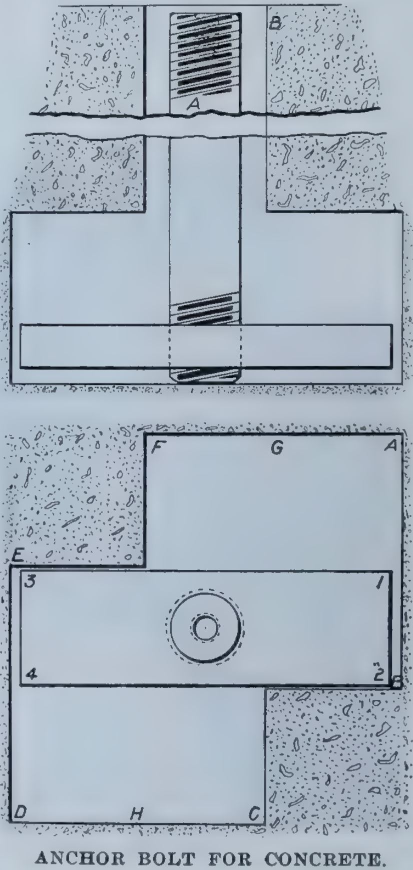
* * *

ANCHOR BOLT FOR CONCRETE.

By James Ellethorn.

THE anchor bolt for concrete shown on page 251 of the August number of **The Power House** has brought to mind a somewhat similar arrangement which came to the writer's attention some time ago. The forms or moulds are made of galvanized iron or other suitable class of sheet metal without top or bottom, and the concrete is run around them. These moulds, of course, cannot be removed when the concrete is set, and must be left in place.

Referring to the sketch, A, B, C, D, E, F, show the shape of the mould for the bolt head, while G, C, H, F outline the shape of the hole extending to the surface of the concrete. The bolt head may either be forged solid with the shank or many be in the form of a nut. When lowered into the hole, it is simply necessary to give it a quarter turn to the position 1, 2, 3, 4, when, upon being raised, it comes into contact with a full area of concrete. The bolt is made short enough to remain entirely below the surface of the concrete when let fall to the bottom.



ANCHOR BOLT FOR CONCRETE.

This allows machinery to be readily moved about over it.

For the purpose of fishing the bolt up through the hole in the machine bed, it can be drilled with a small hole and tapped as at A for the purpose of screwing in a small threaded rod, or a special pair of pliers can be made to accomplish the same thing. If it be desired that the bolts protrude above the concrete, they can be cut of suitable lengths and, by screwing them into the heads until these are clamped tightly against the upper side of the chamber, each bolt is held solidly in place.

A great many advantages of this arrangement are evident. The bolts can be readily removed, replaced or exchanged for different sizes. Again, if the machine be removed, it is an easy matter to fill the hole with a piece of wood until such time as it will be again required.

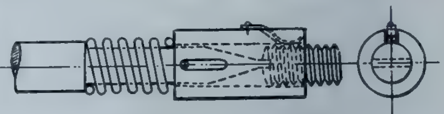
* * *

SCREW-HOLDER AND SCREW-HOLDER.

By C. E. Wyllys.

A CONVENIENT screw-driver and screw-holder, used for inserting screws in assembly work where a long or low reach is required to be made and in which the screw often falls and becomes lost in the process of placing it in the holes, is described here.

In the sketch is shown part of a screw-driver, having one end turned up on which is placed a tension-spring and a round steel sleeve that serves for a screw-holder. The holder is held in place with pin fastened in the screw-driver, and which fits in the slot in the holder. The method of using the screw-driver is to place a screw in the holder, fit the end of the driver in the screw slot, then place the screw in the tapped hole and turn the driver. When the holder is brought up against a machine surface it backs away. A small tempered-spring fastened to the top of the screw-holder prevents the screw from falling out of the holder.



SCREW HOLDER AND SCREW DRIVER.

* * *

Management of Electric Motors.—To get the best results the upkeep of the plant should be considered before installation, and the points to which special attention should be paid are suitability to the requirements, accessibility, the use of the smallest possible number of different sizes of motors, and standardization in every possible way, so that the number of spare parts and replacements which have to be kept in stock may be reduced to the utmost.

Power Plant of the Standard Iron Co., Parry Sound, Ont.

By C.T.R.

Although furnace gas was available, the convenience of gas-fired boilers and the direct rotary drive of steam turbines, together with the ease of starting up, made the use of turbines preferable to that of gas engines for the motive power requirements of this plant.

THE charcoal iron manufacturing plant of the Standard Iron Co., Ltd., situated on an inlet of Georgian Bay, at Parry Sound, Ont., includes among its other interesting features an installation of power equipment which, in addition to its turbo-blower feature, is also unique in the variety of purposes to which steam turbines have been applied.

Boilers.

The steam generating equipment consists of three Robb horizontal return tubular boilers with flush joints, available for the use of either coal or blast furnace gas. Each boiler is 78 ins. diameter by 20 ft. long, and is rated at 200 horse power. There are 2,000 sq. ft. of heating surface, and the working pressure is 150 lbs. per sq. in. The products of combustion are discharged into a 5 ft. dia. x 125 ft. stack.

Steam Turbo-Blower.

For supplying air blast to the furnace, a Fraser & Chalmers Rateau turbine-driven blower is employed. This blower has a capacity of 12,000 cu. ft. of free air per minute delivered at from 6 to 8 lbs. per sq. in., and runs at 4,000 r.p.m. All the bearings are fitted with forced lubrication, oil being delivered from a gear pump driven off the main shaft, and circulating through an oil cooler and filter before being returned to the bearings. The air is taken in through a ¼-in. mesh wire gauze screen and filter outside the building, and is carried in a duct under the turbine room floor to the blower. Non-return and relief valves, which appear in Fig. 1, are provided in the air main to the furnace.

The turbine end of the blowing unit consists of a Fraser & Chalmers impulse steam turbine, taking saturated steam at a boiler pressure of 150 lbs., and exhausting into a low level jet condenser at 28 in. vacuum, referred to 30 in. barometer. The steam consumption is 13.8 lbs. per b.h.p. hour. Non-condensing operation is provided for by the installation of a 10 in. Multiflex atmospheric relief valve and a gate for isolating the condenser. A steam separator is placed between the turbine and the lowest point in the main steam header. The overall dimensions of the turbo-blower, which is illustrated in Fig. 2, are 5 ft. 10 ins x 15 ft. 10 ins. x 6 ft. 2 ins. in height from bottom of bedplate.

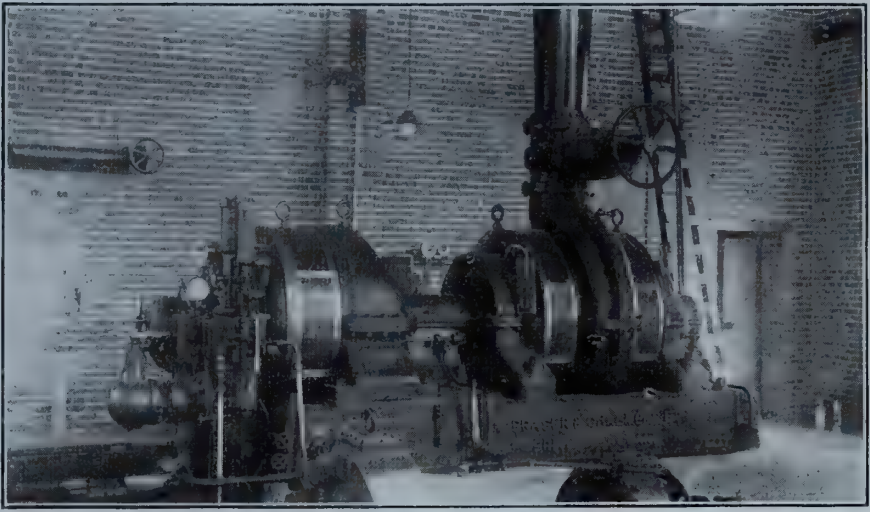


FIG. 2. TURBO-BLOWER ARRANGEMENT.

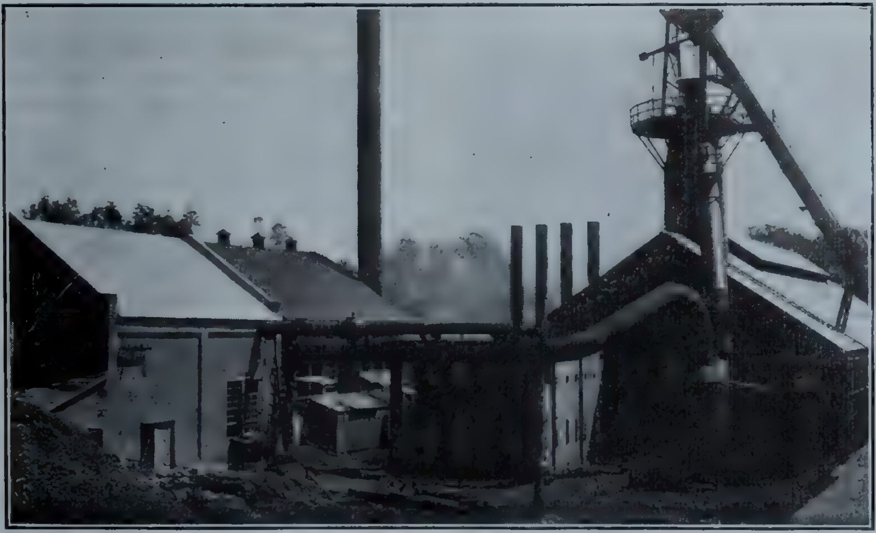


FIG. 1. VIEW OF STANDARD IRON CO. PLANT.

For driving the removal pump of the jet condenser made by the C. H. Wheeler Mfg. Co., a Terry 14 b.h.p. steam turbine is used, running at 1850 r.p.m. The condenser is placed in a basement below the turbine to facilitate the flow of injection water. The vacuum is maintained by a Rotrex dry air pump, engine driven, and withdrawing air from the top of the condenser. Part of the pump is shown in Fig. 3.

Electrical and Pumping Equipment.

The other machines in the power house consist of a 40 k.w. turbo-generator for lighting and power purposes, one 5-in. and one 8-in. turbine driven centrifugal pumps, two duplex outside-packed boiler feed pumps, and a Stillwell closed feed water heater, through which the above units exhaust their steam. The 40 k.w., d.c. generator, see Fig. 3, runs at 2,800 r.p.m., and is driven by a non-condenser Terry steam turbine taking 37¼ pounds of steam per b.h.p. The 5-in. and 8-in. Platt centrifugal pumps operated by Terry turbines are for general service and deliver cooling water to the furnace.

The turbine driving the 5-in. pump, rated at 40 b.h.p., takes 1,500 lbs. of steam per hour non-condensing, see Fig. 4. These pumps together with the condenser, draw their water from a 14-in.

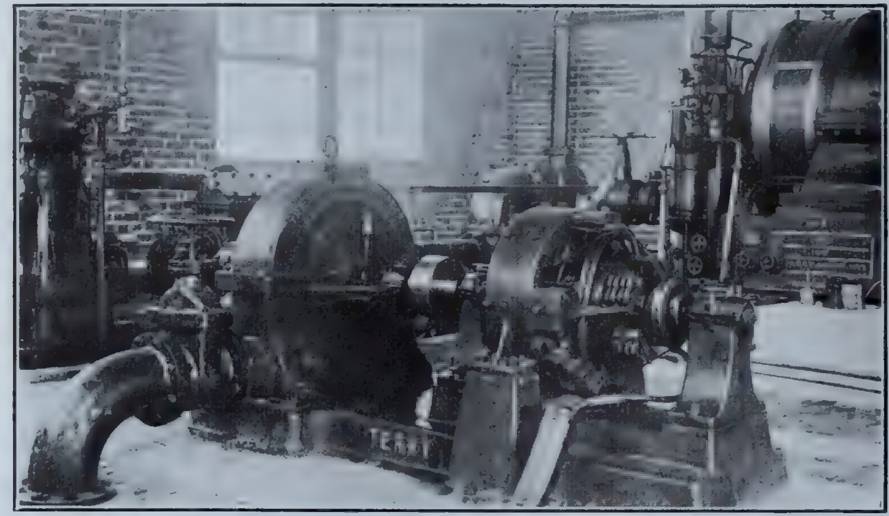


FIG. 3. TERRY STEAM TURBINE AND 40 K.W., D.C. GENERATOR.

suction main running direct from the bay, which is 256 ft. from the power house. The lake level, being 15 ft. 6 in. below the centrifugal pump centres, and 13 ft. 10 in. below the condenser injection inlet, makes an unusually long suction lift. The pumps are primed by a steam injector.

The two duplex Platt feed pumps each have a normal capacity of 108 U.S. gals. per min., and are situated in the boiler room. They are arranged to draw water either from the condenser hot well or from the main centrifugal pump suction line mentioned above. The feed pump discharge is led through the feed heater on its way to the boilers, a bypass being provided for cutting out the heater for cleaning, etc. This will be of rare occurrence, as no oil is carried over with the exhaust from the turbines.

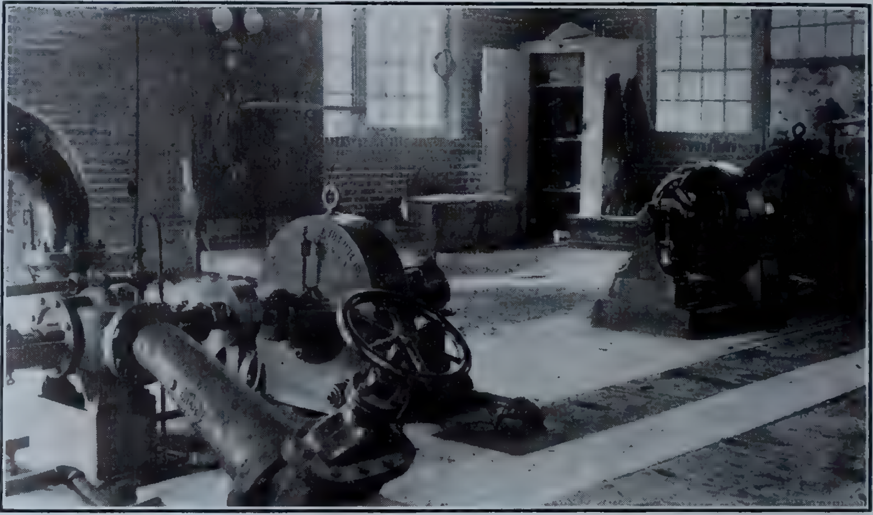


FIG. 5. PLATT 5-IN. CENTRIFUGAL PUMP, 40 K.W. GENERATOR AND TERRY TURBINES.

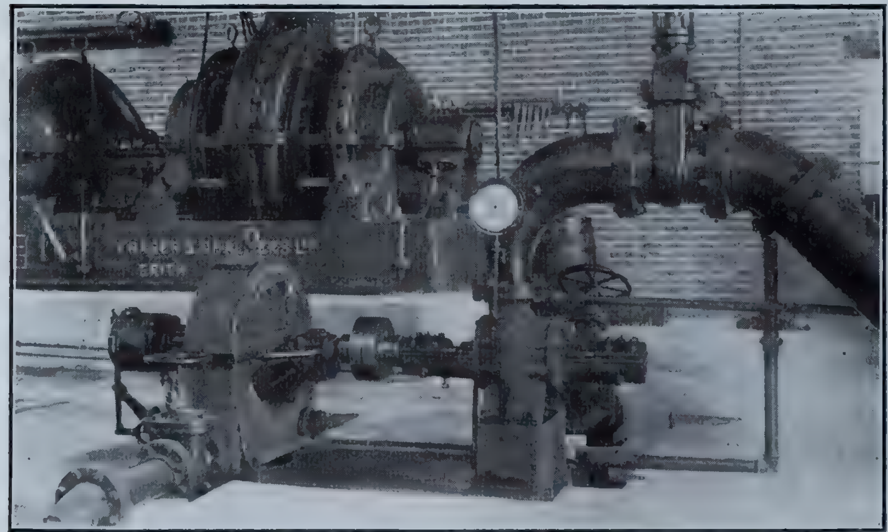


FIG. 4. PLATT CENTRIFUGAL PUMP AND TERRY TURBINE.

Piping.

Steam is conducted from each boiler by a 6-in. branch and an isolating valve leading into a 6-in. steam main to the turbine room, where by a vertical drop of 17 ft. the pipe passes to the level of the trenches in the concrete floor, through which the branches to the different units are led. The vertical length of pipe does away with any necessity for an expansion bend and facilitates drainage, which is designed to gravitate towards the steam separator. Water of condensation is removed by an automatic steam trap directly attached to the separator. Although steam piping in trenches is not usually advantageous, the fact that all the turbines in this instance are placed above the piping renrers the chance of damage by water very remote. The high pressure main and branches above 2 in. dia. consist of extra heavy wrought steel pipe with screwed-on flanges. For 2½ in. dia. and less malleable iron screwed fittings are used.

The blower turbine is connected to the condenser by a large cast iron exhaust bend and a corrugated copper expansion joint. All the other units exhaust into a galvanized wrought steel exhaust main connected to the feed heater. Isolation of the heater is attained by closing a gate valve next the heater, and opening another valve on the exhaust main leading direct to the atmosphere. These valves will also be used in cold weather to build up a slight back pressure for exhaust steam heating. A relief valve is fitted to the main in a conspicuous position to draw attention to any undue rise in pressure.

The water connections to the centrifugal pumps and condenser consist of cast iron flanged pipe with long radius elbows, and taper pipes make connections with the pump branches. The main suction line consists of flanged piping and was tested to a pressure of 30 lbs. per sq. in. after erection to guard against air leaks. In addition to a necessary foot valve at the intake, check valves are placed in the branches to the condenser and feed pumps, and water sealed gate valves in the branches to the centrifugal pumps.

The velocity of water in the suction

FIG. 6. BLAST FURNACE AND PIG BED.

main under normal conditions of working is 280 ft. per min., and the friction head loss between the lake and the pumps is estimated at about 2.7 ft., not including the resistance of the foot valve. The presence of solid rock immediately below the engine room prevented the power house being situated at a lower level, and prohibited the construction of an intake flume. The satisfactory working of the present arrangement shows that any other scheme would have been an unnecessary expense. The feed piping to the boilers is extra heavy, being similar to the main steam piping, and each branch to a boiler is provided with the usual stop, check and feed regulating valves, the latter arranged at the front of each boiler at hand level. With the exception of two angle valves, all water and feed valves are of the straightway type.

Operation Record.

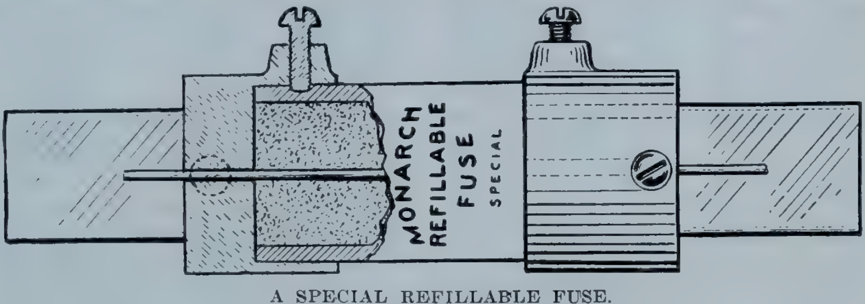
The plant was started up and the blast furnace "blown in" on August 21, 1913, and on August 24 the furnace was tapped and several tons of charcoal pig iron drawn off. The simplicity of operation is quite worthy of comment. In the first place, the boilers are gas fired, and need very little attention, while the only reciprocating motive power is that driving the Pratt Rotrex air pump, and the oiling of that is automatic. The rest of the apparatus is all steam turbo-driven, the result being that the whole plant can be easily handled by one man, and his duties are practically limited to watching the feed water and keeping the log book entered up.

The contractors for the whole equipment were the Rudel-Belnap Machinery Co. of Montreal, and the turbines were supplied and erected by Fraser & Chalmers of Canada, Ltd., Montreal.

A REFILLABLE FUSE.

ON power lines, subject to heavy overloads, sudden motor reversals and similar treatment, in order to afford adequate protection to the machinery on the line, fuses will be blown out more or less frequently. This not only incurs some expense, but the operator is inclined to prevent a recurrence of the trouble by replacing the burnt-out fuse by a stronger one. To simplify the problem of renewals, the Monarch Refillable Fuse Co., of Hamilton, Ont., has developed a special refillable fuse for heavy service, such as cranes, mine hoists, etc.

The caps are of cast brass, fastened to heavy fibre barrels by means of set-screws. The fuse element consists of copper wire held in contact position, also with set-screws. As seen by the illustration, the fuse can be easily renewed by releasing the burnt ends of the old one and clamping the new one in place.



A SPECIAL REFILLABLE FUSE.

* * *

A NEW TYPE OF TRANSMISSION.

By Sidney Caden.

I WOULD like to offer to the readers of your esteemed journal, an idea in connection with power transmission which may, with the help of some better heads than mine, be developed to a stage where the plan will be of some practical value. In a lumber mill where I was employed for some time, it was necessary to operate a small plunger pump at some distance from any line shaft. The power required was almost nominal, and was required more or less in impulses.

A small rope drive was at first tried, but the ropes flopped around too much and, when fenced-in, gave considerable trouble.

A long narrow belt was made by splitting up a wider belt but, in spite of guides this sometimes ran off the pulleys. We were much interested in an article which appeared in a technical paper on steel belting as developed in Germany, and used in both that country and England. This gave us an idea. The two light wooden sheaves used for the rope drive were packed in the V's, with strips of old rubber packing so as to give a smooth, even bottom to the groove. A single band was next made of spring wire brazed together at the ends, and one of the sheaves was made adjustable to take up slackness in the wire.

The arrangement worked very satisfactorily for about a month when the rubber packing in the grooves gave out. This was overcome, however, by substituting leather for the rubber, and the transmission has been running for a year. As an experiment, we set up a three-wire drive for a duplex crank driven pump on the same principle as the American system of rope drive. The sheaves were made of wood, leather covered and, instead of making grooves in the face of the wheels the wires were guided by little rings fastened close to the receiving sides of the sheaves. These guides were very soon worn out, but the wires had by that time made slight depressions in the leather, and the rings were no longer needed.

Adjustment for tension was made in the same way as before, so that only one sheave was required to guide the wire to the starting edge of the driving sheave. This gave remarkably strong turning force with very little tension on the wires. The drive was cheap, light, noiseless and steady and, up to the time I left the plant (three months) had been running without a hitch.

REFRIGERATION DEPARTMENT

FEED SYSTEMS OF REFRIGERATOR COILS.*

By E. S. H. Baars.

WITH the development of the science of refrigeration and the different methods of its application, numerous devices have been designed to supply the refrigerant to the evaporating surface, called throughout this paper the refrigerator coil. Since the surfaces are of varied character, according to the service they have to perform, it is certain that the applications of the feed system are of the same, or of even greater variety, and this gives occasion for discussion, as only one arrangement can be perfect and advisable for a certain arrangement of the refrigerator coil.

Because ammonia predominates as a medium for refrigerating systems, most improvements have been made in connection with apparatus in which it is used, but there is no reason why the same systems, as are used in connection with ammonia, should not be employed in modified form for the other refrigerants, as carbonic acid gas (CO_2) and sulphuric acid gas (SO_2).

Three Groups of Feed Systems.

The feed systems for the refrigerator coil may be divided into three groups—the force feed or direct expansion systems, the gravity feed or flooded systems, and systems which are a combination of the two. In either of the above, the refrigerant is admitted to the refrigerator coil by means of a regulating valve or cock. These are liable to clog up with dirt from the system, and it is also practically impossible to so adjust a number of expansion valves or cocks feeding from a main liquid supply pipe or header, as to obtain an equal supply of refrigerant to each refrigerator coil connected to same.

In practice, refrigerator coils are fed in some cases from the top, in others from the bottom, and the question often arises as to which is the proper way. We find the two methods of feeding practically everywhere, in brine tanks, ice tanks, room piping and in beer coolers. In my estimation there is no reason for the existence of the top expansion system, because it has been found that it is not more efficient than the bottom expansion system. On the other hand, there is danger in operating it, as there is a chance of carrying the liquid over to the compressor. The top expansion system has been used by builders of vernection with horizontal compressors where wet gas has been preferred for operation, also where the forecooling tank coil of an ice freezing system is so arranged that the return gas of the ice tank may pass through on its way to the compressor. The bottom expansion system has been used by builders of vertical compressors, and in such cases where dry gas is essential for the successful operation of the compressor.

Krebs Gravity Feed System.

The deficiencies of the force feed system, relative to proper feeding of a number of coils with one regulating apparatus or a number of coils with a regulating valve for each coil, are all overcome by the gravity feed or flooded systems and, besides, a greater part of the cooling surface is made efficient because the pipe is not needed as liberating surface. The invention of the first of these systems dates as far back as the late eighties. Unfortunately the inventor, H. J. Krebs, was not encouraged enough with the results obtained during the first tests to satisfy him as to the merits of the new system, and consequently further tests were abandoned, the result being that the system was forgotten for years.

Judging from the patent papers it was well designed and would well perform its duty to-day, but without the float operated regulating valve for ammonia. For sulphuric acid gas systems the float arrangement would probably have worked much better, for the reason that with SO_2 a much larger quantity of refrigerant is required for the same number of heat units, which would necessitate such a closely set opening, and further because the difference in pressure between the incoming liquid and the refrigerator coil is about one-third of that in NH_3 system. The float arrangement was replaced by an ordinary feed valve, and in this form the system was manufactured, at least during the last few years of the life of the patent.

Other Gravity Feed Systems.

Two other gravity feed systems are in use to-day in addition to the Krebs' method. These have the same advantages as regards the facility of feeding a number of refrigerator coils at the same time. One system patented by H. Rassbach, as a special feature, the precooling of the refrigerant for the purpose of preventing excessive spraying of the entering mixture of liquid and gas, the latter being created by the sensible heat of the refrigerant.

Another system admits the refrigerant directly into the refrigerator coil and forces the gas, liberated by the sensible heat of the liquid, to pass through the entire coil, the unevaporated liquid being allowed to return through a check valve.

Whether this arrangement is an advantage over others or not should be determined by a comparative test. If a test showed equal results, it would indicate that the disadvantage of passing more gas through the coils would probably be eliminated by a more rapid circulation, and therefore a better heat transfer. The increased speed would also give a higher back pressure at the inlet, and consequently a higher evaporating temperature. It would be necessary, in order to make this third system equally as efficient, as the first two, that the more rapid circulation, and therefore more rapid heat transfer as mentioned above, take care of the losses due to the larger volume of gas in the coil and the higher evaporating temperature.

Gravity feed systems were also patented in Europe and the one patented by Schmitz in 1903 seems to be analogous to and of an earlier date than the above third mentioned system.

Force Feed and Gravity Combinations.

Besides the force feed and gravity feed systems there are several that are more or less a combination of the two. The first to be mentioned are the shell type brine coolers, which can easily be operated flooded because they have a large liberating surface; while a separator in the suction line with a liquid return connection added will certainly insure as good a heat transfer as any gravity feed system.

Another system, installed to improve direct expansion systems, consists of a separator which is placed in the main suction line leading to the compressor, but at such a height that the separated liquid can flow by gravity to a coil of sufficient surface to take care of its evaporation. The return of this coil, of course, goes back to the separator. The separator and the coil are on the true gravity feed system with the exception that the refrigerant does not come direct from the liquor line, but comes from over-fed direct expansion coils.

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*From a paper read before the American Society of Refrigerating Engineers.

From the foregoing, it can be seen that the designer's aim seems to be to install a feed system which will have the cooling surfaces covered with the liquid refrigerant. There is, however, another consideration, and that is the shape of the evaporating surface. As pipes are the most convenient surface, the proposition reduces itself to the selection of the proper diameter of pipe to give the largest surface for the least amount of liquid refrigerant, if the refrigerant is an expensive one.

REFRIGERATION PLANT EFFICIENCY.

By J. E. Phillips.

To obtain the most economical results in operating the refrigerating equipment, we must diversify our efforts, not confining ourselves to any particular part of the power or refrigerating plant, but considering every detail of every part of the combination. What we are all after is to produce power as cheaply as possible and use as little of it as is necessary. There is just about as much to be gained in the average ice plant by using just as little power as is necessary, as there is by making it cheap. It is this combination that counts towards efficiency. The engineer is just as important a factor in the power and refrigeration field as the machinery. The latter, to operate economically, must be of the right design, and to know when it is operating economically, and keep it operating economically, requires the services of an efficient engineer. The writer does not discuss the cost of producing power in this paper, but endeavors to point out some of the unnecessary and avoidable losses that should everlastingly be combated.

The old-time saying, and a true one, "that there is more to be saved in the boiler-room than in the engine-room of the average power plant," can equally be applied to the ice tank or ammonia evaporator of the refrigerating plant. The ammonia evaporator fills the same identical place in the refrigerating plant as does the boiler in the power plant; the analogy between the heat engine and the refrigerating machine being that the steam engine receives heat from the boiler, converts part of it into mechanical work in the engine cylinder, and throws away the difference in the condenser or atmosphere.

The ammonia in the compression refrigerating machine receives heat from the brine tank or cold room, and receives an additional amount of heat from the mechanical work done in the compressor cylinder and throws away the sum in the condenser. The efficiency of the steam engine is work done, divided by heat received from the boiler. The efficiency of the refrigerating machine equals heat received from the brine tank or cold room, divided by heat required to do the work in the compressor cylinder.

Refrigeration Temperatures and Pressures.

In the refrigerating plant the pressure in the condenser should be kept as low as possible, the limit depending upon the temperature and quantity of available water, and the back pressure or suction pressure should be kept as high as possible, the limit depending upon the fixed temperature to be maintained in the brine tank, narrow limits between these pressures being as important to the efficiency of the refrigerating plant as wide ones are to that of the steam plant, in which the economy increases with the range between the boiler and condenser pressures.

MACHINERY EQUIPMENT REQUIRED.

The British Construction Co., Dock Works, Sault Ste. Marie, Ont., with head offices at 39 Victoria St., Westminster, S.W., advise that the undermentioned machinery equipment is required for the permanent plant at Sault Ste. Marie. In view of the fact that the structural feature of such an undertaking involves the lapse of some considerable time before the installation of equipment can take place, actual purchase of the various units enumerated will not take place until next year.

AIR COMPRESSORS.

2—Belt-driven air compressors, complete with motors (A.C.), capacity 1,500 feet; pressure, 80-100 lbs. each.

2—Belt-driven air compressors, complete with motors, air receivers, pipes and fittings (A.C.), 1,500 ft. per min.; pressure 80-100 lbs.

DRY DOCK PUMPS.

2—Centrifugals (vertical type), electrically operated, each capable of pumping out dock in 2 hours; dock 850 ft. x 100 ft. x 22 ft. (total av. depth).

1—Centrifugal 6 in. drainage pump.

BLACKSMITH SHOP.

Fan and equipment.

Attainment of the highest suction or back pressure within the limit of the temperature to be maintained in the brine depends upon the method of applying the cooling effect of ammonia; and this general principle can be borne out as giving the best results for the least square feet of pipe surface used in the refrigerator. Rapid circulation of the brine, as much ammonia liquid, and as little ammonia gas in contact with the cooling oils as possible, are the important factors. The reason for this is that gas transmits heat only about one-thirtieth as fast as liquid. The best refrigerator of to-day, I claim, is the shell type brine cooler, where the liquid ammonia boils in contact with pipes through which the brine to be cooled is rapidly circulated, and in my opinion the nearest approach to the above mentioned brine cooler is the so-called flooded system.

To obtain the lowest condenser or discharge pressure within the limit of the temperature and quantity of available water supply, depends upon the design of the condenser and the effective application of the cooling water. Recently condensers have been invented wherein sufficient condensed ammonia is retained to absorb the incoming gases, the absorption of heat being direct between the liquid ammonia within the pipes and the water flowing over same. These condensers are said to be very effective, and that there is only a few degrees difference between the temperature of the liquid ammonia leaving the condenser and the initial temperature of the cooling water; consequently, a low discharge pressure.

Volumetric Efficiency of Compressor.

The volumetric efficiency of the compressor is the ratio of the weight of ammonia pumped to the amount calculated from the piston displacement, and depends upon the amount of clearance, area of inlet and discharge valves, and the condition of gas entering the cylinder, whether dry, saturated or superheated; also the provisions made for the taking care of cylinder heating due to compression. The proper insulation of the various parts of the refrigerating plant plays no small part in making it efficient. The refrigerating tanks, the cold rooms, the brine pipes, the ammonia suction lines between the refrigerators and compressors, the liquid ammonia pipes and liquid receiver—in fact, everything that is colder than the surrounding atmosphere, should be properly insulated. To avoid depression in pressure between the ammonia evaporators and the compressor, the suction lines should be amply large.

Having the above mentioned parts of the proper design, it only remains for the engineer to keep them in proper shape to give the most efficient performance. By keeping the interior and exterior surfaces of the evaporator and condenser perfectly clean, and by the intelligent use of the indicator and the thermometer, the power necssary to produce a ton of ice will be the minimum.

From a paper read at the Annual Convention of the Practical Refrigerating Engineers' Association.

Light, Heat and Ventilation

LIGHTING OF METAL WORKING PLANTS.*

Good lighting in industrial plants is an essential to satisfactory and efficient operation, and a summary of the contributory reasons may be said to include the following:—

Correct illumination reduces the number of accidents, makes a more sanitary shop, results in more agreeable and comfortable working conditions, protects the eyes of the worker, increases the amount of output, improves the quality of production, decreases the percentage of seconds, reduces the cost of the lighting itself in many instances; all of which factors combine to raise the standard of the organization along humanitarian and economic lines.

Methods of Lighting.

In general we may classify lighting systems in two ways; first as to the means of getting the light to the working plane or surface to be illuminated, and, second, as to the arrangement of units.

1.—Three systems of lighting are generally recognized: direct, indirect and semi-indirect. The last two require ceilings clean and light in color, and since in the majority of metal working plants the ceiling is either dirty or broken by trusses and skylights, the first alone is discussed here. (The authors consider a direct lighting unit as one from which over half of the emitted light flux is directed downward or to the side, reaching the surface to be illuminated without being reflected by the walls or ceilings.)

2.—The lighting units may be arranged in three fashions, furnishing what are frequently termed local, general and localized-general or group lighting. Naturally, combinations of these may be derived. General illumination supplemented by local lighting is often good practice and is much more frequently employed than any of the other combinations possible.

Local Lighting.—This system consists of the use of the smaller sizes of incandescent lamps placed close to the work and under the control of the workman. This system of illumination is inherently bad, for it produces a high intensity over but a small area, leaving the rest of the room in comparative darkness. Thus, whenever a workman looks away from his work, a certain time element is needed in order that his eyes may accommodate themselves to this great change in intensity. Very often the illumination on the work is far too great for the operation performed, which often results in ocular fatigue. In addition, when using this system the workmen lose time in adjusting their lamps and the breakage is increased by handling. It is true that there are certain processes where it is necessary to use a local lamp; for instance, when inspecting the interior of a mould or deep boring, or where extremely fine work is in progress, such as the manufacture of watch parts. In the last instance, it would be inadvisable to light the entire room with the very high intensity required by the work. In cases where local lighting is essential it is advisable to provide a moderate value of general illumination to prevent a great contrast in intensity.

General Lighting.—In this system, medium or high candle-power lamps are employed. They are spaced systematically with reference to the building construction, and such reflectors chosen as will produce approximately even illumination over the entire area. It has special application in large, open spaces where heavy work is done, such as rolling mills, forge shops, foundries, etc. Where closer work is carried on, a modification of this system should be used, for it is desirable here to have the maximum intensity at the working points with lower values between machines.

Localized-General or Group Lighting.—This is the system referred to a modification of general lighting. As its title implies, the lamps are located with respect to the work, medium size units being hung at moderate heights. The disadvantages noted under local lighting are done away with, and as satisfactory results are obtained as with general lighting and not as much energy is necessary.

Lamps.

Tungsten filament lamps are standard for 105 to 125 volts in steps from 10 to 1,000 watts, at efficiencies ranging from 1.30 to 0.55 w. p. h. cp. respectively. For multiple operation on circuits from 220 to 250 volts, the standardized lamps range from 25 to 500 watts with efficiencies varying from 1.33 to 1.00 w. p. c. In average practice, local lighting employs the smaller sizes, 10 to 40 watts; the localized-general system utilizes from 60 to 150 watts, and general illumination is supplied by lamps between 100 and 1,000 watts. Naturally, special cases produce deviations from this grouping.

Reflectors.

Reflecting devices may in general be divided into two groups — glass and metal. Glass reflectors may be very efficient and produce excellent illuminating results, and in the case of translucent types make a bright and cheerful shop. However, in industrial service the danger of breakage is an element which has prevented their adoption by the majority of plant managers. Another point, which often makes their use inadvisable, is the question of cleaning. Everyone realizes that periodical cleaning of lamp and reflector is extremely desirable and necessary if the system is to operate at its most efficient point. Nevertheless, in too high a number of cases this is neglected. In such instances an opaque metal reflector, if covered with a layer of dust on the outer surface, does not present as untidy an appearance as a dirty translucent reflector.

In practically all the plants investigated by the authors, metal reflectors were used, and their experience has indicated that a well made porcelain enamel finish is most generally opplicable for this phase of lighting, on account of its ease of cleaning, resistance to acid fumes, heat and moisture, high initial efficiency and lack of permanent depreciation.

A great deal has been said of the deep bowl versus the shallow dome shape. From a standpoint of eye protection, the deep bowl is to be preferred, but the investigation showed a far greater number of the dome shape in service. It is true that a large percentage of these may have been installed through clever salesmanship, or due to the fact that the lamp is visible, also the exposed filament gives the layman the impression that he is getting more light. Yet, the shallow type has certain inherent advantages which indicate that in spite of the theoretical disadvantages, it is the shape which is of most general service. These are as follows:

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*From a paper read at the recent convention of the Illuminating Engineering Society, in Cleveland, Ohio.

The downward flux of light for a given wattage is considerably greater than with a deep bowl reflector; more light is emitted at the obtuse angles, producing better illumination over vertical surfaces; light escapes near the horizontal, permitting use on quite wide spacings without dark spots midway between the units; and lastly, a brighter and more cheerful shop results. Of course, the hanging height must be such that the lamps are well above the angles of the vision and, when this factor is taken care of, the glaring effect is not severe, as the light emitted at high angle makes the walls bright and lessens the contrast between lighting unit and background.

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CHAIN SOCKET FOR ELECTRIC LAMPS.

THE Monarch Electric Co., of St. Lambert, P.Q., have recently put on the market a new chain socket for electric lamps. The construction of this new socket is very substantial and simple. It consists of a base, pull chain, switch mechanism, lamp holder, brass shell, cap and necessary insulating fibre.

The base consists of two pieces of unglazed porcelain, and between these pieces are located the various links which constitute the switch mechanism. The supports for the top piece of porcelain and the current carrying parts are mounted in grooves on the lower porcelain to prevent turning. There are three brass supports carrying the top piece of porcelain. These struts are about 0.05 inches in thickness. The first is a support for the chain bell, while the other two act as terminals. These latter are provided with upturned lugs for holding the wires under the binding screw heads. The screws used are No. 5, of 40 threads per inch. The spacing points of opposite polarity are everywhere spaced at 3-64 of an inch apart or a greater distance.

CHAIN SOCKET FOR ELECTRIC LAMPS.

The lamp holder is of the standard Edison screw shell design, and is held to the base by two screws. One of these screws is the current carrying conductor to the shell. The other screw is of opposite polarity and extends through the central portion of the base and through a large hole in the holder. Washers of mica capped by a smaller brass washer communicate pressure to the internal flange of the holder. Thus by means of the second screw and a direct pressure, the holder is rigidly attached to the porcelain base. The sealing is done by wax which will not melt at 200° F., and is made in compliance with rule No. 72 of the National Electric Code.

COMBINATION FIXTURE SOCKET, DIM-A-LITE AND SHADE HOLDER.

The cap is brass and of the usual fixture type. The method of fastening it to the shell is somewhat unique. On the body of the shell about 3-32 of an inch from the top are two groups of four outpressed lugs. These are pressed out from the body of the shell and the groups are diametrically opposite each other. The cap is provided with an interior brass ring punched with a series of rectangular holes to engage with the outstanding lugs. The holes are so punched that the cap will fit on the body when simply pushed over it. It is therefore unnecessary to twist the cap until the holes and lugs register against each other. The shell and cap are both lined with heavy fibre approximately 0.035 of an inch thick. The chain is of the universal design, the inner end lying in a channel of white horn fibre.

The switch mechanism is of the single pole, single break type. It is very simply constructed. A flat rectangular piece of porcelain is mounted on a central pin, and one side of this porcelain is faced with a copper conductor connecting with the central pin which is in turn connected with the central terminal screw. This rectangular porcelain is made to go through one-half a revolution each time the chain is pulled. The motion is accomplished by means of two springs and a cam. Thus every other time the chain is pulled, the flat non-conducting side of the rectangular porcelain piece is pressed against the terminal and the current is broken. Further, every other time the chain is pulled, the copper faced side of the porcelain is in contact with the terminal and the circuit is complete.

COMBINATION SOCKET, DIM-A-LITE AND SHADE HOLDER.

THE accompanying illustrations show a new type of dim-a-lite, recently put on the market, which is a combination of a fixture socket, a dim-a-lite, and a shade holder. It is made to be fastened permanently to the fixture stem with thread and set screw, and wired to the chandelier or fixture in the same manner as an ordinary socket. The dim-a-lite as a portable attachment that can be easily unscrewed from the fixture socket and removed is well known, but this new

The dimming features are the same as in the standard pull chain dim-a-lite, but the operation is entirely different. Instead of pulling a chain to obtain the different degrees of light, a slight turn of the shade is all that is needed to get the five changes of light; viz., full-on, dim, low, night-light, out. The dimming is effected by means of a series of helically wound resistance coils, properly insulated and connected to contact bars.

CHAIN SOCKET FOR ELECTRIC LAMPS.

The Vacuum System of Heating for Industrial Plants

By W. H. Baldwin *

The necessity for heating factory, office, and public buildings during the major portion of each year on this continent, has called forth both engineering ingenuity and enterprise, and the economic aspect of the subject naturally appeals to those who manage and direct such institutions, affecting as it does the three-fold feature of employees' welfare, production, and fuel expenditure.

DURING the last ten years, manufacturing plants in Canada and the United States have made wonderful strides in their development. Improved methods and better machinery have gone a long way towards cheapening production and improving the quality of the product, and were, of course, the first to receive the attention of the up-to-date manufacturer.

At the present time it is not an unusual thing to see large quantities of practically new equipment being scrapped to make room for improved machines which will increase the production of the plant and do it at a lower cost. Large sums of money are also being spent annually by wide-awake manufacturers in order to maintain cost-keeping departments which have for their aim the efficiency determination of each individual unit.

Another thing receiving more attention now than formerly, is the care being given employees in the matter of comfort while on duty. Manufacturers have found that it pays to have men comfortable, and in many of the factories being built to-day, particular attention is being given to the features of ventilation, heat and light.

Exhaust steam Waste.

However, in a relatively large percentage of our plants, there occurs a leak that is two-fold in its effect, and I know of no better way to get an idea of its enormous extent than to go to the top of some tall building, overlooking the manufacturing section of our cities, on a cold day and see the volume of exhaust steam being poured out. This exhaust steam represents thousands of dollars annually in coal bills.

In order to see the other result—go down to one of these factories from which the cloud of steam is rising and look at the workmen. It is more than probable that you will find them bundled up in heavy clothing trying to keep warm. You will see, perhaps, a workman trying to make a difficult adjustment on a machine. He is a good mechanic—he has to be to do the work required of him, and is receiving good wages; still, as you watch him, you think it takes a long time to make the adjustment and start the machine. You are right in thinking so too, for it has probably taken him twice as long as it would, had the building been comfortably warm. To put his thoughts in words, "his hands are so cold that his fingers are all thumbs."

Sometimes conditions are worse than above noted. I have in mind a small plant manufacturing a commodity that required practically the whole factory force to be skilled mechanics and well-paid men. During an extra severe winter, this factory lost thirty-two hours each day in one of its departments due to the fact that it was so cold for the first hour or so in the morning that the men could not work; still at the time, there was enough exhaust steam being wasted to have heated all the buildings comfortably. Not only did they lose the wages of the men during this time, but the output of the factory was cut down an equivalent amount at a time when it should have been running at full capacity. The saving occasioned by the use of a vacuum system of heating in each instance would alone have been sufficient to warrant its use. Another advantage, which applies particularly to Canadian factories, is that it may be extended to care for future additions without increasing the back pressure on the engines to any great degree, and still get the water of condensation back to the boilers at a very high temperature.

Applicable to Heating System Extension.

I have an instance in mind in which the back pressure on the engines was decreased by making an extension of the heating system. The plant in which this occurred had originally a surplus of exhaust steam over that necessary to heat its buildings and the back pressure valve was set to maintain a pressure of about one pound on the heating mains and allow the surplus steam to escape to the atmosphere. A new warehouse was added later and the radiation in it was sufficient to raise the total amount of radiation to an amount which was slightly in excess of that which could be supplied by the engines in severe weather. The effect was, that the radiation, acting as a condenser, condensed the steam faster than the engine supplied it and instead of the gauge showing a pressure on the exhaust main, it showed a vacuum of from two or three inches. The vacuum pump maintained the circulation of steam through the radiators and heated the buildings satisfactorily.

The value of such a condition as this may not at first become apparent to the reader. This vacuum condition means more horse-power from the engines with the same consumption of steam, or the same horse-power, with a smaller consumption of steam, yet at the same time the smaller amount of steam available from the engines was sufficient to heat all the radiating surface because of the positive circulation due to the vacuum pump.

Thermostatic Trap Feature.

What has been stated would of course, have been impossible without the use of a thermostatic trap on the radiators, as the thermostatic trap remains wide open until the steam comes in contact with its disc, thus allowing an unobstructed passage through which the suction from the pump can act upon the air in the radiator, pulling it out and filling the radiator with steam, even though it may be at a pressure lower than that of the atmosphere. Then, as soon as the radiator is filled with steam, the trap closes so that only the water condensing in the radiator is allowed to pass out. This prevents the steam from entering only part of the radiators and insures an even distribution of steam all over the system.

The hollow disc thermostatic type of trap has a hollow collapsible disc in which is a mixture of volatile fluids which vaporize and condense in direct proportion to the changes in temperature. Since temperature is the most potent and positive factor in heating, it is the most reliable of nature's forces to govern the opening and closing of a radiator steam trap. Of course, exhaust steam is used for heating purposes without employing the vacuum system. It has the disadvantage however, that it is necessary to carry a considerable back pressure in order to get circulation, also, there is more or less difficulty in getting the air out of the radiator and in getting the water back to the boiler-room, unless there be a considerable grade down to the boiler room.

In a gravity system there is almost sure to be a part of your radiation in-

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*Heating Engineer, the C. A. Dunham Co., Toronto.

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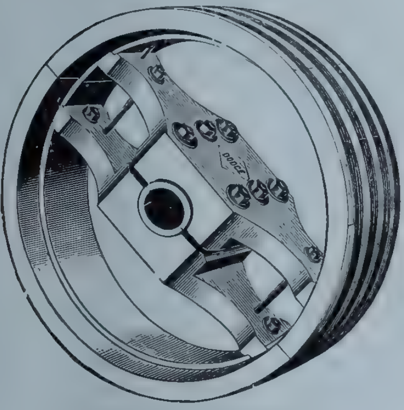

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Dodge Wood-Split Pulleys

are balanced and run true. They are the result of selected, seasoned, kiln-dried stock, combined with skilled workmanship and 25 years of "knowing how!"

Over a million in successful operation, and the output is increasing each year.

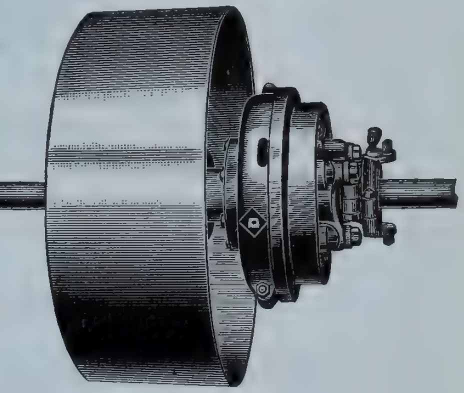
The Dodge Pulley can be quickly and easily mounted on the shaft. It has interchangeable bushings, and can be made to fit any size shaft. The belt surface enables the belting to get an efficient grip — it saves power.

Dodge Ball and Socket Adjustable Hangers

are smooth road-beds for power.

Dodge Bearings reduce friction because there is a true ball and socket connection between the bearing and the frame in Hangers and Pillow Blocks, which permits the bearing to freely align with the shaft.

Dodge Hangers and Pillow Blocks are furnished with ring or capillary self-oiling bearings, all lined with a high-grade metal, and BORED and REAMED. One filling of oil will last three to six months.



Dodge Friction Clutch

This Friction Clutch cuts off power in the nick of time—thus putting your men and machines on the safe side.

It can be put up or taken down without disturbing other equipment. Can be used as a cut-off coupling, for driving pulley or rope sheave, or for attachment to quill carrying a main driving wheel.

Can you afford to have machines idle while repairs are being made, or employes suing for damages on account of injury?

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Eastern Branch House, 640 St. Paul St., Montreal

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active and this is especially true in extremely cold weather. During very cold weather when the radiators are condensing their maximum amount, the fall in pressure through a radiator is so great that the steam is short circuited through the return pipe and flows to the radiator through both supply and return connections. The result is that the air and water are held up in the radiator and its efficiency is reduced. The vacuum system is also more efficient than a gravity system in saving and using the heat in the steam for heating purposes. This is illustrated very clearly by the following case:—

A Vacuum System Record.

Two years ago a large mining company in the West installed a vacuum system to take the place of a two-pipe gravity system then in use for heating their buildings. As the mines were located at a very high elevation and in a very mountainous district, the cost of transportation made the price of coal very high, and a close account of the coal used was kept the year round. After the vacuum system was installed, the record of coal consumption was compared, and it was found that a net saving of 23 per cent. had been effected. As there was a total of about 35,000 square feet of heating surface on this job and the heating season was practically twelve months of the year, and as their coal cost around $10 a ton, this meant some saving.

Of course, this was an extreme case, caused by extreme conditions, but on the average the saving effected by a vacuum system is well worth considering by the manufacturer who expects to cut his cost of production down to where he can compete successfully with foreign manufacturers.

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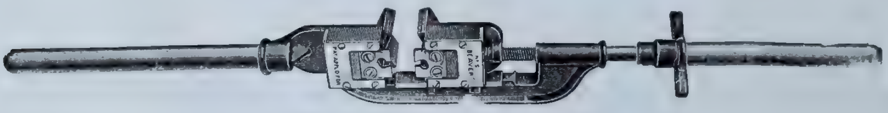
SQUARE END PIPE CUTTER.

FOR years, hand pipe cutters have labored under the drawback that the metal of the cut was simply squeezed out, not removed. This produced a large burr both inside and out, which, for most purposes, must be removed and, for the more particular jobs, making the pipe quite unserviceable.

To overcome these troubles, the Borden-Canadian Company of Toronto have brought out the square end cutter shown in the illustration. The device is simplicity itself, consisting of a heavy frame which carries the guide vees, the handles, and the cutters. These cutters are fed to their work by compression springs, the depth of cut being accurately regulated by the opposite leg of the cutting tool. The tools last a long time without regrinding and when necessary, this can be easily done.



SQUARE END PIPE CUTTER.

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NEW DOUBLE PURPOSE FILTER.

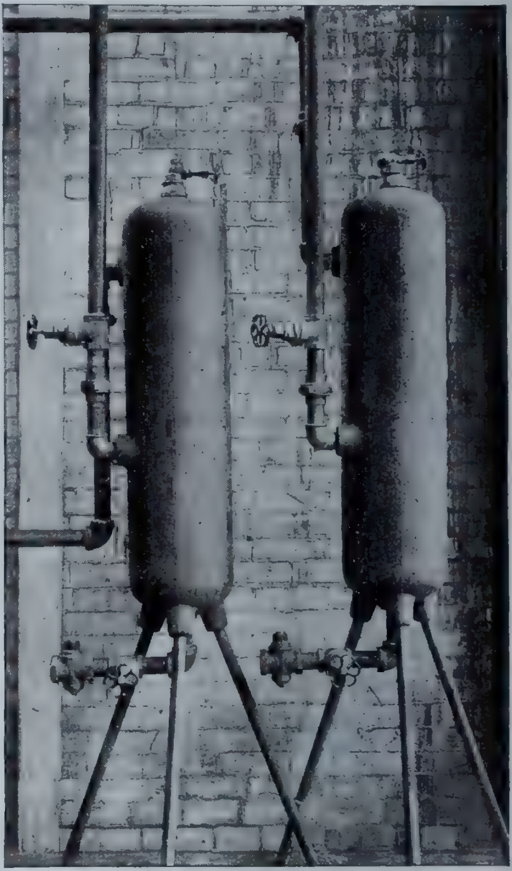
THERE has recently been put on the market a simple and ingenious device for the purpose of continuously removing impurities from the water as they are precipitated in the boiler. The system depends for its success largely upon a rapid forced circulation of the water in the boiler, the value of which as a help to raising steam is well known to all engineers. This forced circulation does not require pumps or other mechanical means for its maintenance, but is brought about by the arrangement of the apparatus itself.

The Scale Feature.

The principal scale forming materials are known to be the carbonates and sulphates of calcum and magnesia. The carbonates are precipitated at about 212 degrees F., or the boiling point of water at atmospheric pressure, while the sulphates are not brought down until a temperature of 300 deg. F. is reached. This represents a pressure of about 52 pounds gauge, the complete action taking place between this and 60 pounds. It is seen that the carbonates or soft scale can be removed in an open heater, which has a filter attached. The usual method of dealing with the sulphates which form the hard scale is to add soda ash or potash to the feed water before it enters the heater. The action of these substances is to change the sulphates to carbonates or to soft scale, which can then be removed in the filter, as before stated.

The new device does away with the use of compounds of soda, etc., and all auxiliary filters, in that with it the carbonates may be removed before the water enters the boiler in the usual way. The sulpahtes are precipitated in the boiler, but, on account of the rapid circulation, are not allowed to settle there, being carried to the filter and there deposited.

Two of these filters are shown in the accompanying half-tone. The body is of cast iron, and is in a single piece. The lower pipe connection is for the purpose of blowing off the accumulated impurities; the middle ones comes from the top part of the boiler just below the waterline, and the upper pipe goes down to the floor and rises to the lowest part of the boiler through the fire box. The filtering material is placed in the top part of the filter and, on account of the facility for cleaning by blowing off, lasts indefinitely. The section which goes through the fire box is larger than the rest of the pipe system, and passes upwards in a steady slope through the hottest part of the fire. This produces a strong circulation similar in principle to that obtained in the hot water heating system and the ordinary kitchen range boiler.

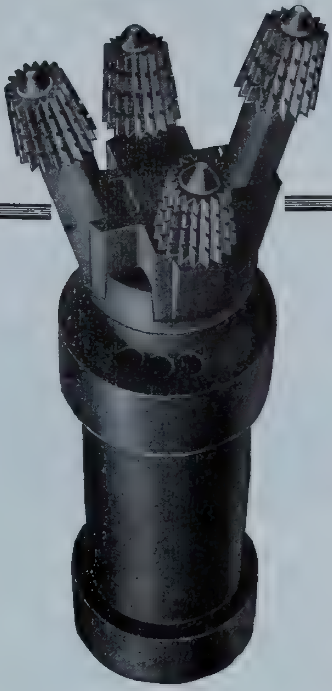


NEW DOUBLE PURPOSE FILTER

It is seen that if the piping be well lagged, little or no loss of heat is encountered, and that an amount of water equal to the capacity of the boiler would pass through the filter a number of times in the course of a day. Also with this forced circulation added to the natural circulation due to the steaming of the boiler, mud, precipitated salts and other such imprities would have little opportunity of settling upon the boiler heating surface. The advantages to be derived from the enforced circulation from a steaming point of view would not be so marked in water tube boilers as in tubular boilers, where no definite circulation exists. The above apparatus is known as the Carter Filter, and is made in Toronto, Canada, by the Siemon Company, Ltd.

Liberty Boiler Tube Cleaners

will keep your boilers clear and free from scale, and are the very cheapest insurance against Accidents.



A LARGE majority of boiler explosions are caused by an accumulation of scale. The scale coating prevents the water from reaching the iron, and the intense heat soon burns out the tube.

Besides eliminating the danger of accidents, there is the fuel saving which will in a short time repay the cost of a LIBERTY CLEANER.

Ask any of your friends that have used our Cleaners what they think of them. If you write us, we will give the name of a user of our Cleaners in your own City or vicinity.

Write for Catalogue "H" which will tell you about our different types of Cleaners for all kinds of water or fire tube boilers.

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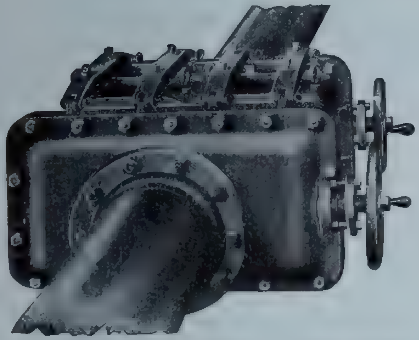

Horizontal position, doors on top.

Do your condenser tubes become clogged with rubbish?

Do your pump valves get stopped up, cut out, need constant attention?

Do you have trouble with any of your water handling machinery, on account of the leaves, sticks, grass, etc., in your service water?

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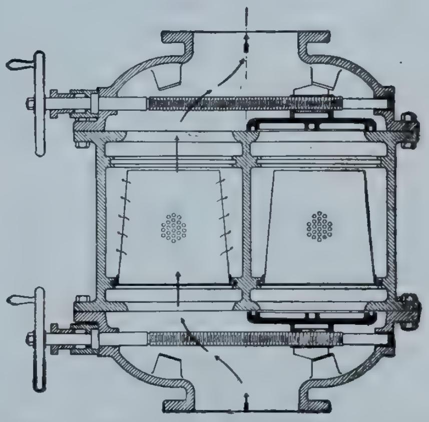

Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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Relative to Steam Pipe Arrangement in the Power Plant--I.

By G. W. Sutcliffe, Wh. Sc.

This writing is a recapitulation of the principal matter contained in a series of articles, the compilation of which was the result of observation and experience derived from the inspection and other records of the Vulcan Boiler and General Insurance Co., Manchester,

ACCIDENTS more or less serious in the material sense, and generally equal as to loss of life when compared with actual boiler explosions, are all too common experiences resulting from badly laid-out, faultily-constructed, ill-adapted material of, and carelessly operated steam pipe lines, valves, fittings, connections and supports. The data here given is quite comprehensive in its scope, and is such as to make direct appeal to all interested in steam power plant practice.

Drainage of Water.

Sectional Area of Pipe.—This should suffice to pass the required amount of steam at a mean velocity of 100 ft. per second at 100 lbs. pressure, or at 60 ft. per second at 200 lbs. pressure. At 12 lbs. vacuum, the velocity should not exceed 350 ft. per second. Higher velocities are liable to be attended with excessive vibration.

Accumulation of Water.—This must be prevented. Pipes nominally horizontal should drain with the current, say, with a fall of not less than one foot in 500, accurately determined. Pipes falling towards boilers are attended with grave danger.

Safety and Length of Service.—The safety of any particular arrangement cannot be held to be established by length of service. Several serious accidents have occurred to plants after twenty or thirty years of uninterrupted work.

Discharge of Water under Steam Pressure.—This is always attended with danger.

Drainage Fittings.—These are required at each low point and air discharge cocks at each high point.

Vacuum Valves.—Such valves to admit air may suffice in exceptional cases to avert water-hammer, but they are not reliable.

Boiler Stop Valves.—These should be arranged to keep clear from water on both sides. The whole system may be divided into sections; each preferably with long falls and short vertical or steep rises.

Water Separators.—Water entrained in steam from boiler or precipitated by condensation should be removed by separator. In minor positions the pipe may be modified to act as a drainage leg. In either case the condensed water should be removed by automatic steam trap. The separator should be arranged for the steam to impinge upon a perforated plate; also with access openings.

Straight-line Stop Valves. — Such valves of the screw down type, when placed in a horizontal pipe, should be placed with the spindle horizontally to give free drainage of water and discharge of air.

Steam Traps.—These are employed to control the adjustment of drainage discharge valves by automatic means which are more or less peculiar to each type of trap. Many modern traps give a flush or intermittent discharge by which wear of the valve surfaces is much reduced. A dirt interceptor should always be interposed before the steam trap to prevent the access of foreign matter to the valve surfaces. If this is omitted, the valve surfaces abrade and fail to close completely. The retained matter should be removed by free scouring at frequent intervals. A trap should be ordered to discharge — gallons per hour, in flushes at — gallons per second, at a steam pressure of — lbs. per square inch on gauge, and to deliver the effluent water at a level of — ft. above or below the trap.

Sundry Pipes.—Pipes required for drainage, heating, or other purposes should be arranged, as far as possible, parallel and neatly fixed against a wall or foundation. Levels should drain accurately, and if any pipe is intended to be continuously hot, space should be allowed for the necessary covering. All joints should be freely accessible and flanges or unions provided for convenience in taking apart.

Effluent Pipes.—All these should deliver separately into a drainage tank, conveniently accessible and arranged for convenience in ascertaining quantities of water delivered.

Pressure and Temperature.

High Pressure means High Temperature.—Steam of high pressure only exists at a correspondingly high temperature, and any water freshly formed by condensation from such steam also exists at the same temperature. If such water is withdrawn by means of an automatic steam trap or a manually-operated cock, it immediately becomes exposed only to atmospheric pressure and falls to the corresponding temperature of 212 deg. Fah., thereby suffering loss of heat and loss of weight by evaporation. In many cases these losses may be prevented or minimized by judicious arrangement of the pipe leading to the point of relief, so that this shall present surface sufficient to distribute the required amount of heat and to effect some useful application of this heat.

Pipes and Pipe Flanges.

Cast Iron Pipes.—This was the only material available for pipes in the early days of the steam engine. For the moderate pressures at that time current, this material was not very unsuitable, but it is most objectionable for high pressures. It is seldom free from defects—obvious or concealed—and it is conspicuously imperfect in regard to elasticity. When exposed to high pressure and especially to superheat temperatures, it is liable to continuous depreciation in strength and also to become porous.

Copper Pipes.—This metal is unfitted for exposure to high temperatures; it is better suited for withstanding vibration, and is particularly useful for prompt and convenient application to irregular lines and positions, especially in small sizes. In large sizes, copper pipes are usually made by bending plates, the longitudinal joint and the flanges being secured by brazing, which determines the line of weakness. Solid drawn copper pipes are in general much superior, but are almost equally unfitted for exposure to high temperatures.

Mild Steel Pipes.—These are best obtained by solid drawing process. Lap welding is, however, most frequently adopted, and in general such pipes are reliable and efficient; the same applies to welded flanges. Exceptional cases of lap weld and flanges are given in which serious failures have developed.

Cast Steel Pipes.—These are adopted for special purposes, particularly for bends to suit limited space; also for all valve casings and like fittings for use with steam of high pressure, or with superheated steam. Notwithstanding the time occupied in annealing, this operation should not be curtailed. Special examination should be made as to uniformity of thickness and for sponginess, also hydraulic pressure tests, after machining and on completion.

Pipe Flanges.—These are best welded solid with the pipe. Sometimes they are fixed by screw threads, which are good for normal treatment, but bad for strain or vibration. A raised screw thread may succeed where the stress and strain

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Mechanical Draft

This photograph is not an accident. It is merely an incident in the new order of things. For years this chimney supplied the draft for a large Illinois plant but finally gave way to a better system.

Mechanical draft has many very decided advantages over natural draft. Here they are:---

- **More steam from your boilers.**
- **Sudden demands for power easily met.**
- **Steam pressure can be kept absolutely constant.**
- **In connection with mechanical stokers, it tremendously increases boiler capacity — more than 200% rated capacity is often obtained.**
- **More draft and just when you want it.**
- **Decreases smoke.**
- **Peak loads handled with ease.**
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- **Can be used where building restrictions forbid high stacks.**
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There are hundreds and hundreds of successful Sturtevant Forced and Induced Draft Systems all over the world. Each one is designed for the special needs of the plant.

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are too great for a thread of ordinary type. A failure of a screw thread is generally shown in first instance by leakage along the thread; when this occurs to any marked extent, the conditions should be corrected. If neglected, the pipe may pull out of the flange. Riveted flanges are stronger and more reliable than screwed ones. The heads of rivets should be ample. The same applies to fixing of branches.

Bends of Mild Steel.—These should not be curved to a radius of less than three times the bore. The thickness of material may with advantage be one-sixteenth of an inch greater than that of straight pipes, to allow for drawing down.

Bends of Cast Steel.—These may be curved to a radius equal to the bore, but they are much better made to a radius 25 to 50 per cent. greater.

Importance of Uniform Strength and Elasticity.—The strength and elasticity of the system should in all cases be kept as uniform as possible. In case screw threads are adopted, the best results are obtained by raising these above the outer diameter of the pipe to make the thickness beneath the thread uniform with the rest of the pipe. To this, however, there are practical difficulties, and to avoid them the screw threads are usually cut out of the pipe, but the loss of strength is partially corrected by gradually running out the thread.

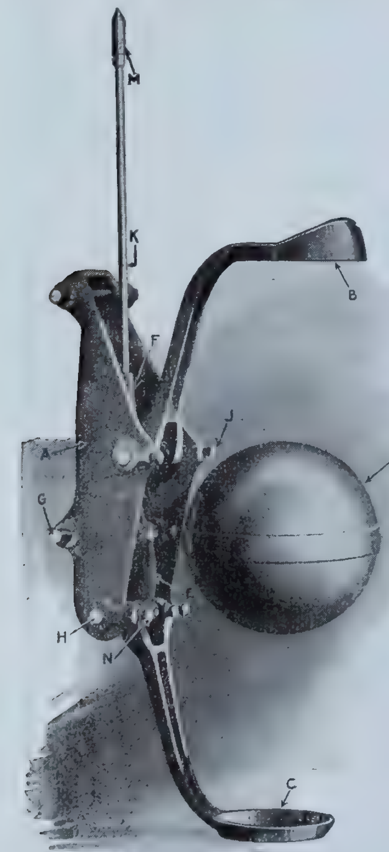


FIG. 1. OPERATING MECHANISM OF WATER COLUMN.

Screw Threads.—Where screw threads are used for uniting pipes and flanges, they should taper slightly in diameter to compress the paste used for jointing, thereby promoting soundness of joint.

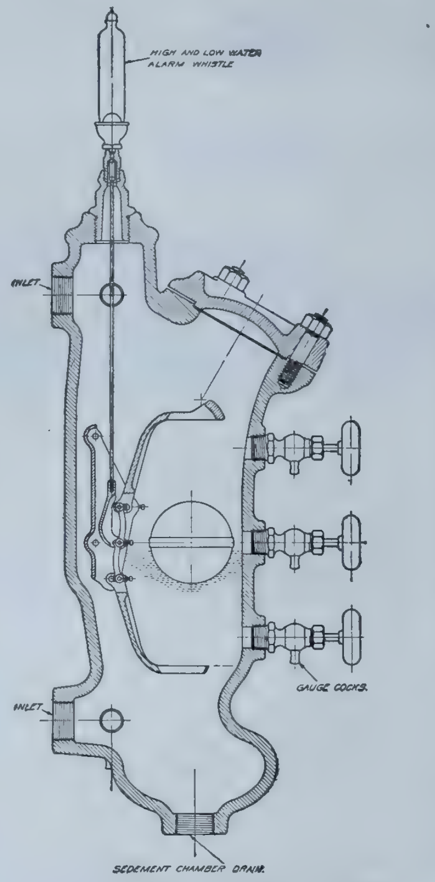


FIG. 2. SECTION THROUGH WATER COLUMN.

Couplings and Branches. — Socket couplings may be used for special purposes, but subject to skilled attention in examination and erection. Branches of small size cannot be fixed in wrought steel pipes by simple drilling and screwing, as the thickness of main pipe is insufficient; therefore, forged bosses are necessary, and these should be carried outward to clear the pipe covering; such steam branches usually on top and drainage branches below.

⁂

SAFETY WATER COLUMN AND STEAM SEPARATOR.

FIGURE 1 shows the operating mechanism of the Anderson safety water column with high and low water alarm. All of the working parts are assembled in the removable hanger frame A, which is secured in the body of the column by means of the pins G. When the water rises in the boiler to the high point, the float D strikes the top lever B, which draws the whistle valve M from the valve seat. At the low water point, the float strikes lever C, which opens the whistle valve through the link E.

These columns are made in different sizes, suitable for different sizes and types of boilers, and Figure 2 shows a section through column, the large sediment chamber in the bottom being noteworthy.

The Anderson steam separator is shown in Figure 3. This separator consists of the body with the outlet extending up about half-way through it. The head, which screws to the body, is fitted with a bell-shaped cone, to which is fastened a set of spiral baffles. The steam enters through the head, strikes the cone, and is given a spiral or whirling motion by the baffles which throws the moisture against the body, the steam passing out under the cone. The moisture is prevented from following the steam by the deflector at the top of the discharge opening, and is drained off through the globe valve at the separator bottom to a steam trap. They are made in all sizes from 1½ ins. to 12 ins., in both vertical and horizontal types, by the V. D. Anderson Co., Cleveland, Ohio., who are also manufacturers of the safety water column.

⁂

J. C. Ross has been appointed chief engineer of the Yarmouth Light & Power Co., of Yarmouth, N.S.

James S. Martin, for five years vice-president of the Martin Pump & Machine Co., died on Oct. 12, at his home, 163 Duchess street, Toronto, having taken a stroke in his office a week ago. The deceased, who had resided in Toronto since 1850, and was 73 years of age, was born in Dundee, Scotland.

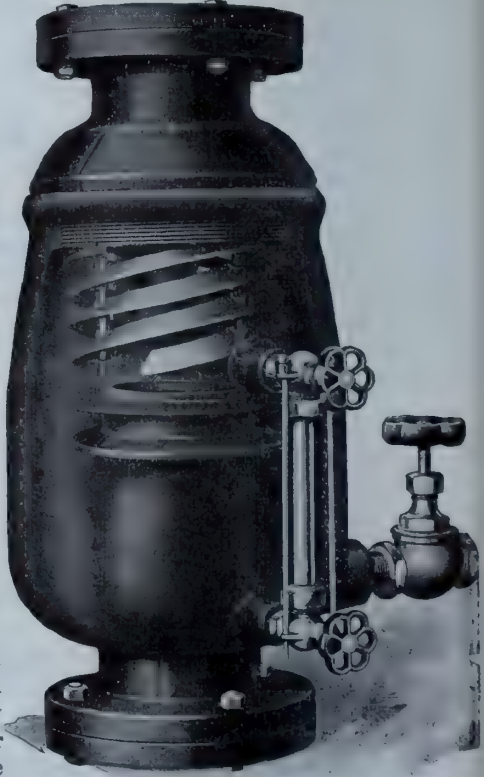
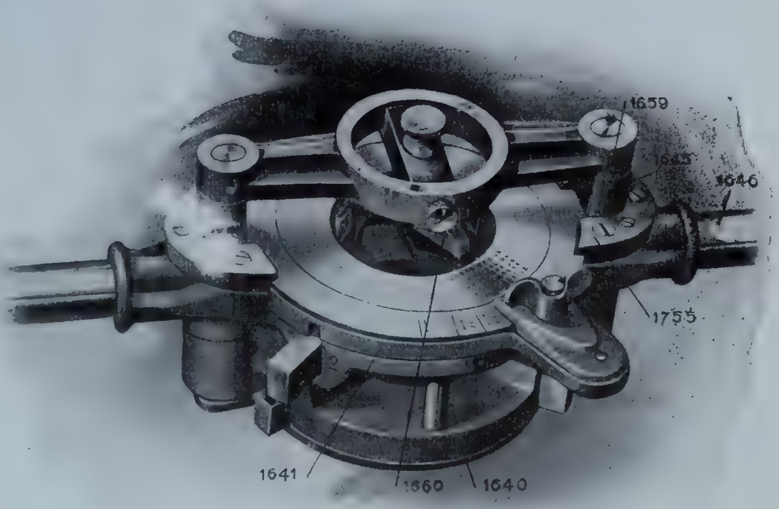


FIG. 3. PHANTOM VIEW OF STEAM SEPARATOR.

High Grade
Pipe Threading and Cutting Tools

"Premier" Die Stocks

No. 1—½ to 1¼ inch Right or Left
No. 2—1 to 2 inch Right or Left
WITH ONE SET OF DIES



Starts itself on the pipe and automatically throws itself out after a "Briggs" Standard Thread is cut, instead of backing off, which spoils the dies. **The troublesome leader screws and nuts are eliminated.** The new patented offset Die, which can be used only in the "Premier," has overcome the difficulties. The die is made in such a way that once over the pipe, it accomplishes what any other make would in going over twice, as one set of teeth is lower than the other, consequently every tooth does an equal amount of work.

No separate bushings or dies to carry around and lose. The Premier has but one lock, and that is used only when changing from one size to another. The centering device has a scroll cam, without locks, which operates the three jaws that guide the stock on pipe.

Very easily operated. **Write for full particulars.**

Beaverette ¼-¾, one set of Dies.
No. 25 Beaver—1 to 2 inch, right hand only.
No. 41 Beaver—2¼ to 4 inch, right hand only.
No. 60 Beaver—2½ to 6 inch, right hand only.
No. 80 Beaver—4 to 8 inch, right hand only.

"Beaver" Die Stocks
(Adjustable)

The only tool made with a universal chuck. This means your pipe is always straight, and no grip screws or bushings to bother with.

The Beaver cuts a tapered thread with a narrow die similar to a lathe tool by moving or expanding the die while the thread is being cut.

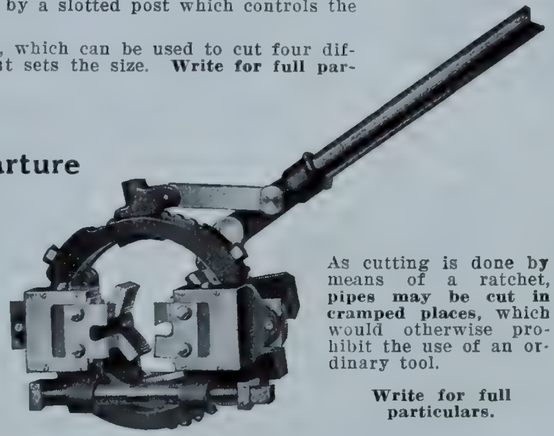
The Die cam is revolved positively by a slotted post which controls the taper.

Each stock contains one set of dies, which can be used to cut four different threads—a twist of the wrist sets the size. **Write for full particulars.**

This new 2½ in. to 4 in. Pipe Cutter is a radical departure from the standard design of pipe-cutting tools.

It is capable of cutting off a 4 in. pipe in four minutes by a man using one hand only. THE CUT IS PARTICULARLY CLEAN, there being a CONSPICUOUS ABSENCE OF BURRS, inside and outside. **Pipe never becomes split or distorted**, while the cutter can be quickly adjusted to fit any size from 2½ in. to 4 in.

Will cut through a tread as quickly and squarely as a piece of straight pipe.



As cutting is done by means of a ratchet, **pipes may be cut in cramped places**, which would otherwise prohibit the use of an ordinary tool.

Write for full particulars.

Borden-Canadian Company
66 Richmond St. East, Toronto, Ont.

Personal

Harry Newman in charge of the city sales department of the Montreal branch of the Canadian Fairbanks-Morse Co., was married at St. Paul's church, Montreal, on September 8, to Miss Marjorie Ross, eldest daughter of Col. F. G. Ross, of Montreal.

W. R. Burge, of the Jenckes Machine Co., Sherbrooke, Que., has been promoted to the managership of the company's Toronto office, and will leave for that city shortly. Mr. Burge has been with the Jenckes Machine Co. for fourteen years and his many friends will congratulate him upon his well deserved promotion.

E. J. Reed, formerly sales manager to Miles, Sykes & Son, Ltd., and for several years chief publicity writer to the British Westinghouse Co., has been appointed advertising manager to Ed. Bennis & Co., of Bolton, England, the well-known manufacturers of mechanical stoking apparatus, etc. The offices of the Publicity Department are at 28 Victoria Street, London, S.W.

Trade Gossip

Francis Hankin & Co., Montreal, have received an order for a 10-in. Simplex Venturi water meter from the City of Regina.

The Canadian Griscom-Russell Co. has been granted a license to carry on business in the Province of Ontario, with office in Toronto.

Keith's, Ltd., Toronto, have been awarded the contract for the refrigerating equipment of the new Central Technical School, Toronto.

St. Vital, Man.—The contract has been awarded to the Manitoba Engineering and Construction Co., of Winnipeg, for laying water mains, valves, hydrants, etc.

The Decarie Boiler & Incinerator Co., has been incorporated with head office at Vancouver, B.C., for the manufacture of boilers and incinerators. The capital of the company is $20,000.

The Bennett & Wright Co., Toronto, have been awarded the contract for the ventilating and heating of the Huron and Essex schools in that city. The total value of contracts amounts to $9,821.

Hotson, Leader & Goode, contractors, of Lethbridge, Alta., have secured a contract from the town of Cranbrook to the amount of about $80,000 for the laying of a water system. Mr. Goode is now in Cranbrook supervising the commencement of the work.

The Canadian Fairbanks-Morse Co., Toronto office, have received an order for the complete transmission equipment for Soren Bros., new factory on King street West, Toronto. Skefko patent double row, self-aligning, ball bearings will be installed throughout.

Toronto, Ont.—The Board of Control has divided the contract for the 7,000 feet of 2½-inch fire hose required this year as follows: Gutta Percha & Rubber Co., 2,500 feet Paragon hose, $1.05 a foot; Dunlop Tire & Rubber Goods Co., 2,500 feet, $1.05 a foot; Goodyear Tire & Rubber Co., 2,000 feet Magnet hose at 95c. a foot.

Beaverton, Ont.—The new power plant at Wasdell Falls was formerly set in motion by Sir Adam Beck on Oct. 6. The plant, which is located on the Severn river, is part of the Provincial hydro-electric system, and was constructed to supply power to the surrounding municipalities. The plant has a capacity of 1200 h.p.

Regina, Sask.—The Ferranti Electric Co. have been awarded the contract for the supply of a 10-h.p. motor, the price being $496. Pipe connections for a new 300-k.w. turbine will be supplied by the Crane, Ordway Co. at a cost of $3,464. A contract was also awarded to Vagg, Wilson & Co. for the installation of a heating plant for the offices of the city's construction departments.

Catalogues

Lubricators.—The Detroit Lubricator Co., Detroit, Mich., and Walkerville, Ont., have issued an illustrated leaflet descriptive of the Detroit improved standard lubricator. A full description covering the design of the lubricator and method of operation is given, accompanied by illustrations showing interior and exterior views.

The Graton & Knight Mfg. Co., Worcester, Mass., are distributing among their friends an exceedingly attractive circular breathing the spirit of the Thanksgiving season, recently past. Typical Thanksgiving scenes are portrayed in a seasonable color scheme, while the reading matter touches on incidents associated with this festive season.

Pulleys with Leather Rims are described in a catalogue issued by the Belt Grip Pulley Co., Buffalo, N. Y. The claims for this type of pulley are set forth in detail with illustrations showing the principal features embodied in the construction. Other lines dealt with are leather casters for furniture and truck wheels, floor scrapers and line hooks.

Automatic Heat Control is the subject of a bulletin recently received from the Monometer Mfg. Co., Birmingham, England. The Monometer self-acting heat regulator is an apparatus adapted for the regulation of temperature in furnaces, ovens, distilling plants, etc. using gas or oil fuel. The various applications of this apparatus and claims made for it are set forth in detail.

Pneumatic Tools.—The Independent Pneumatic Tool Co., Chicago, Ill., is mailing to the trade a circular "V" just off the press. The circular is descriptive of the "Thor" line of roller bearing piston air drills, pneumatic clipping, caulking and flue beading hammers, turbine drills, staybolt drivers, air hose couplings, etc. Each line is illustrated and accompanied by a brief description, while a specification for each is also included.

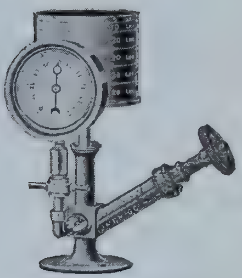
Steam Pumps.—The Smart-Turner Machine Co., Hamilton, Ont., have sent us a copy of catalogue No. 9, illustrating some of the later designs of power and steam pumps. Price lists have been purposely ommitted, as these may be found in other catalogues, and the whole space has been devoted to illustrations and brief descriptions. What is given, however, serves to show some of the various types of pumps which the company makes. Fuller particulars can be obtained direct.

Chloride Accumulators.—The Canadian General Electric Co., Toronto, are distributing section "A" of a catalogue describing the chloride and Tudor accumulators for electric railway service, central lighting and power stations, isolated lighting and power plants, interlocking switch and signal service, telegraph, fire-alarm systems, etc. In addition to the numerous illustrations covering the various types, the catalogue contains several tables giving considerable information regarding these accumulators such as sizes, weights, prices, etc.

S. E. A. Rings made by Ronald Trist & Co., London, Eng., are dealt with in a leaflet just to hand. The chief feature to be noted is an extract of data taken during a series of tests made on these rings at the National Conservatory of Arts, Paris, France. Comparisons were obtained between S. E. A. rings and plaited cotton and asbestos, and showing a considerable reduction in rod friction for the S. E. A. type of ring. Particulars of the tests are given with the judges' remarks. The leaflet is got up in an attractive manner and may be obtained from the Canadian H. W. Johns-Manville Co., Toronto, or branches.

Grinnell Sprinklers.—We have received a copy of the quarterly (October) number of the Grinnell Automatic

Recording Pressure Gauge



Pressure Gauge Testing Outfit

The

J.M.T.

Trade-Mark has stood for unalterable quality and business integrity for over thirty-five years.

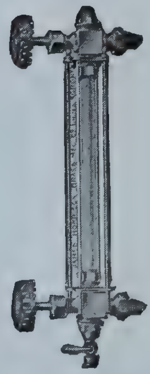
You can rely upon Steam Goods and Specialties bearing this Trade-Mark.

Valves,
Pressure and Recording Gauges,
Injectors,
Steam Whistles,
Ejectors,
Steam Cocks,
Inspirators,
Safety Valves,
Reducing Valves,
Marine and Locomotive Brass Work, Etc.

The James Morrison Brass Mfg. Co.
LIMITED
93-97 Adelaide Street West, Toronto, Canada

Pop Safety Valve

Gate Valve

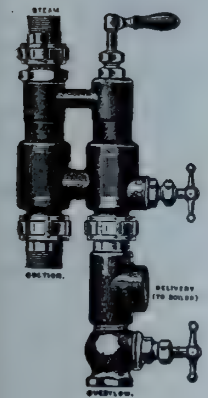


Water Gauge Mounting

J. M. T. Automatic Injector

Straightway Radiator Valve

Hose Gate Valve with Hose Cap.



Genuine Hancock Inspirator

Gauge or Try Cock

Steam Gauge

Gem Ejector

J. M. T. Reducing Pressure Valve

Classified Advertisements

Those who wish to sell or buy a business, obtain competent help, connect with satisfactory positions, or secure aid in starting new enterprises, should not fail to use the Want Ad. Page of The Power House.

Do you want to sell or buy a second hand engine or any other equipment? Let The Power House pick out a seller or buyer for you.

There is always some one looking for just such proposition as you have to offer.

RATES (payable in advance):—2c. per word first insertion, 1c. per word subsequent insertion, 5c. additional each insertion when Box Number is required. Each figure counts as one word.

MISCELLANEOUS

SUCTION GAS PRODUCER ENGINEERS can learn of the best coal by addressing Charles W. Mooers, Elmira, N.Y., U.S.A.

HAWKINS *LIBRARY OF* ELECTRICITY

In 6 Leather Pocket Books

Price per Volume $1

Here is a set of books that no man in the ELECTRICAL FIELD should do without. This is the ELECTRICAL AGE in which we live; ELECTRICITY now controls more trades, directs more men, offers more opportunities than any other power that man has yet discovered. Do you wish to know the underlying principles of MODERN ELECTRICAL PRACTICE?

If so, **HAWKINS ELECTRICAL GUIDES** will give you the information. In reality they are a school within themselves, containing a complete study course with QUESTIONS, ANSWERS AND ILLUSTRATIONS, written in plain everyday language so that a practical man can understand the "HOW, WHEN AND WHY" OF ELECTRICITY.

HAWKINS ELECTRICAL GUIDE No 1
PRINCIPLES OF ELECTRICITY MAGNETISM INDUCTION EXPERIMENTS DYNAMO
HAWKINS ELECTRICAL GUIDE No 2
HAWKINS ELECTRICAL GUIDE No 3
DYNAMOS MOTORS TESTING
HAWKINS ELECTRICAL GUIDE No 4
WIRING AND SYSTEMS STORAGE BATTERIES
HAWKINS ELECTRICAL GUIDE No 5
CURRENTS AND ALTERNATORS
HAWKINS ELECTRICAL GUIDE No 6
A-C MOTORS CONVERTERS RECTIFIERS
HAWKINS ELECTRICAL GUIDE No 6 WITH QUESTIONS ANSWERS AND ILLUSTRATIONS

"THAT'S JUST WHAT I NEED"

Read over the titles shown on the back of each volume, and note the scope of each book. They are handsomely bound in flexible black leather with gold edges and will readily go in the pocket. THEY ARE NOT ONLY THE BEST, BUT THE CHEAPEST WORKS PUBLISHED ON ELECTRICITY.

Each book is complete in itself and will be supplied $1.00 per copy, but we believe that the complete set is the best bargain.

The books can speak for themselves and a careful examination, page by page, and illustration by illustration, will convince you of their big value.

If you will fill out the following coupon giving all the information requested, WE WILL SUBMIT THE SIX VOLUMES FOR EXAMINATION ON CONDITIONS NAMED.

FREE EXAMINATION OFFER

THEO. AUDEL & CO., 72 5th Ave., NEW YORK

Please submit me for examination HAWKINS ELECTRICAL GUIDES (Price $1 each.)

Ship at once, prepaid the 6 numbers; if satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature ....

Occupation ....

Business Address ....

Residence ....

Reference ....

WANTED

ENGINEER WANTS POSITION—I have had good practical experience in engineering, steamfitting, etc.; am familiar with and can apply money-saving ideas in operating, particularly in stoking. I understand and have operated refrigerating machinery in well-known plant. Can install Boilers and power plant equipment, train stokers, etc. Position in right plant and not salary principal object. Address Box 145, The Power House, Toronto.

WANTED, FIRM WITH CONNECTION among steam users to take up sole agency for old-established Metallic Engine Packing. Box 118, "The Power House," 88 Fleet Street, London, England.

FOR SALE

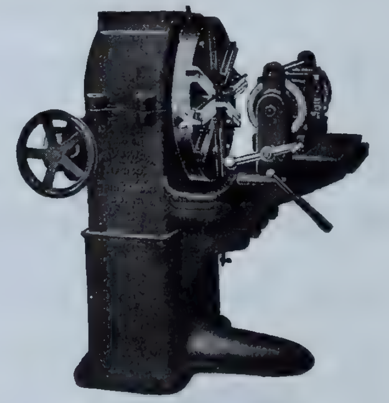
ENGINE FOR SALE—ONE 65 H. P. NASH 3 cylinder gas engine direct connected to 40 k.w. Fine shape. Guaranteed. With switchboard. Good for picture theatre or garage. Will sell on time. The Meriam Co., Cleveland, O. (10)

THE LONG (Patent)
STEAM TRAP

Regulated to work against any pressure between 1 and 200 lbs., and is capable of draining from 900 to 1,500 feet of 1-inch pipe. Works automatically. No valves except those which control the admission of steam to the apparatus to which the trap is attached. Starts when steam appears. Being open at starting, **cannot become air bound, thus doing away with air cocks or vents.** Can be installed in any position, and will **never freeze** if set so as to drain when leaving at night. You need it.

Write for full particulars.

J. T. LONG
69 4th Ave., Maisonneuve
MONTREAL, QUE.



No. 3 PIPE MACHINE

THREADS AND CUTS OFF PIPE FROM 1 TO 6 INCHES

A Very Desirable Machine for

PLUMBERS and STEAM FITTERS

Manufactured by

THE ARMSTRONG MFG. CO.
298 KNOWLTON ST.
BRIDGEPORT, CONN.

Write for Catalog

NEW YORK CHICAGO

Sprinkler Bulletin published by the General Fire Extinguisher Co., New York. The bulletin is gotten up in the usual attractive style and contains in addition to general matter pertaining to the Grinnell sprinkler, a reference to the fire at Salem, Mass, together with photo; also a description with illustrations of the sprinkler system installed at the new State pier, Providence, R.I. On the front cover is a diagram of a typical sprinkler system showing the general layout in a factory building.

Corliss Engines made by the Vilter Mfg. Co., Milwaukee, Wis., are dealt with in an attractive catalogue which we have recently received. In presenting this catalogue an endeavor has been made to state in a brief and comprehensive manner, the main features of the company's line of modern Corliss steam engines with their latest additions and improvements. The design of the engines is discussed in detail, each part being taken in turn and described at length. The latter are illustrated in conjunction with the text, while other illustrations show general views of the various types made. The concluding pages give h.p. formulae for simple and compound engines accompanied by some useful tables giving the cut-off at various percentages of stroke, and for variour pressures. Horse-power tables for rolling mill type engines are also included. The catalogue is well got up and the illustrations very clear.

Book Reviews

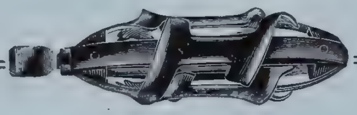
The Origin of Coal, by David White and Dr. Thiessen is the title of bulletin No. 38, published by the Bureau of Mines Department of the Interior, Washington, D.C. The purpose of the studies that form the basis of this report was to learn from microscopic examinations of coal how far and in what way the grouping of coal by types depends on differences in the kind of plant material from which it was formed and on the conditions of its accumulation, or how far the special characters and qualities of coal of any type were determined by the nature and the state of the plant debris from which the coal was formed. The bulletin contains much interesting and useful information on the subject and in addition contains a chapter on the formation of peat, by Charles A. Davis. A feature of this work is a number of plates, 54 in all, showing various samples of coal. These are particularly valuable in explaining the text.

Centrifugal Compressors, by Louis C. Loewenstein, Engineer, Turbine Department of the General Electric Co., Schenectady, N.Y. This booklet is a reprint from the General Electric Review and deals fully with centrifugal compressors, their design and application. There are 31 pages, each containing much valuable matter pertaining to the subject. The opening pages deal with the development and design of the centrifugal compressor, giving comparisons with other types of compressors, such as positive pressure blowers and reciprocating compressors. The distinctive features of the various types are analysed carefully and the claim for the centrifugal compressor set forth in detail. The concluding pages are devoted to the application of the centrifugal compressor and deal fully with each and every class of work where a compressor of this type can be used satisfactorily. A few of the applications included are as follows:—Blast furnace work, cupola work Bessemer converters, pneumatic conveyors for various purposes, ash conveying, etc. The booklet is fully illustrated and in addition contains efficiency diagrams and tables, together with some useful data and calculations on air pressure and compressors. Copies may be obtained from the Canadian General Electric Co., Toronto.

Furnace Efficiency by James C. Peebles—156 pages indexed—69 illustrations. Published by the Joseph K. Branch Publishing Co., Chicago, Ill.—Price $1.50. The fact that the coal supply is not inexhaustible and should therefore be used as economically as possible is the main idea that prompted the writing of this book. The necessity of reducing expenses to a minimum and obtaining the highest possible efficiency was another important consideration. The book explains how waste can be reduced to a minimum and describes mechanical apparatus which can be used to advantage in securing the highest efficiency. There are thirteen chapters dealing successively with such subjects as chemistry of combustion, flue gas analysis, reduction of losses in the boiler furnace, draft losses in furnace and boiler, smoke and its prevention, smokeless furnaces, Wilsey fuel economy gauge, Blonck efficiency meter, chain-grate stoker, Jones under-feed stoker, arches, breeching and smokestack. Each subject is dealt with in a comprehensive and practical manner, while with each chapter there is a series of questions and answers which help materially in obtaining a proper understanding of the text. The illustrations include various types of stokers and furnaces, efficiency curves, etc. Smoke consumption and furnace efficiency are allied subjects which are being given a great deal of consideration at the present time and a book devoted to their study should meet with a favorable reception. This being a practical work, it will be read with interest and profit by engineers.

MONCRIEFF'S "UNIFIC"
WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

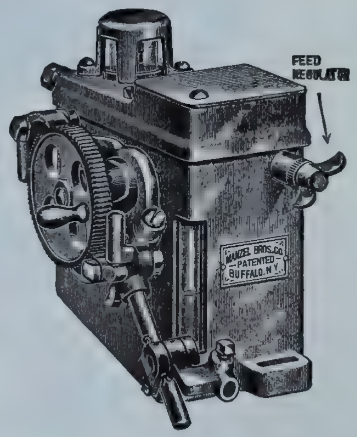
Model A, $1.10 per inch.
THOMAS' IDEAL FLUE CLEANER
Patent 1911
Has cutting edges of chisel shearing shape on both ends, which shave flue as clean as day it was made. Adjustable to wear—easily sharpened—strongly built. Made to do the work.
The IDEAL is the most perfect cleaner on the market to-day.
Sold on guarantee from your dealer or direct from manufacturer.
Manufactured by
S. I. THOMAS, 6 Afton Ave.
Toronto, Can.
Model B, $1.00 per inch.



DIXON'S GRAPHITE
CUP GREASES
You can't compare Dixon's with any other cup greases, because no other grease uses the genuine natural Ticonderoga flake graphite. These graphite flakes are the only true lubricant — a lubricant that identifies itself with the metal of bearings in a lubricating veneer that only grows smoother and firmer with use and increasing pressure. Dixon's comes in six grades of hardness. If you don't know which you ought to use, tell us your conditions and we'll send the right sample.
Made in Jersey City, N.J., by the
JOSEPH DIXON CRUCIBLE CO.
Established 1827.

SAVE OIL, TIME AND MONEY
A Bowser Oil Clarifying System enables you to control your oil expenditures, and to KNOW where all the money goes. Let us tell you something about it.
BOWSER ESTABLISHED 1885 Oil Clarifying Systems
Increase the efficiency of your engine room. It costs nothing to find out. Write NOW.
S. F. BOWSER & CO., 330 Frazer Ave., Toronto, Ont.

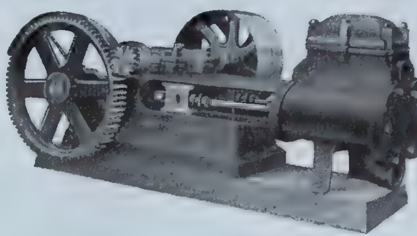
Manzel Oil Pumps


FEED REGULATOR
MANZEL BROS. CO.
PATENTED
BUFFALO, N.Y.

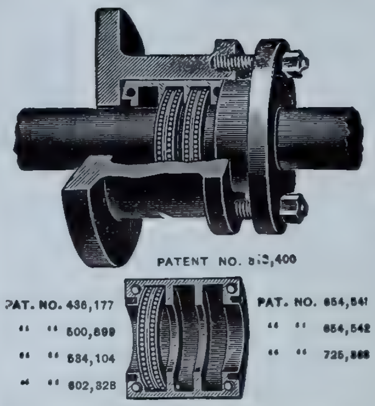
Guaranteed to Save 50 Per Cent. Of Your Oil
This Automatic Force and Sight Feed Pump feeds oil into the Cylinders regularly and positively all the time—no matter how slow the engine runs, what pressure the steam is carried, how high or low the temperature. Not a drop of oil goes to waste.
Sent on 30 days' FREE Trial. If not equal to word for word of our guarantee simply return it at our expense.
Try it now.
The Twin City Oil Co.
General Agents for Canada
BERLIN, ONT.
Manzel Brothers Company,
Buffalo, N. Y.

HINTS TO BUYERS

COMBINE PATRIOTISM WITH ECONOMY
by buying SMART-TURNER
Made-in-Canada Pumps
Ultimately the cheapest.



THE SMART-TURNER MACHINE COMPANY, Limited
HAMILTON - - CANADA



Why not Buy the Best, when in market for Packing?

HOLMES'

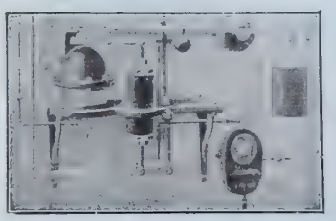
Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

"THOMPSON"



A positive coal saver.
A safeguard against excessive steam pressure

THE
"THOMPSON"

Automatic Damper and Pressure Regulator

has the power to move the damper or dampers in both directions by water pressure.

It will operate on a variation of one pound of steam.

Write for prices.

RICHARD THOMPSON & CO.
126 Liberty Street, New York

"Twentieth Century"

HIGH-GRADE OILS

Lubriko V Russian Gas Engine Oil — Will run your large gas engine perfectly when all other oils fail.

Lubriko Y Russian Gas Engine Oil has very low cold test, good viscosity, no carbon; specially suitable for silent Knight engines.

Lubriko Russian Ammonia Oil is specially adapted for use in ammonia and ice machine plants, giving perfect lubrication at a very low degree of temperature.

Lubriko Russian Electric Motor Oil is the one motor oil suitable for use in all climates, and will in no way gum the motor.

Lubriko Russian Engine Oil is the highest grade engine oil produced.

Lubriko Russian Stainless Oil is used in knitting and white goods plants, where an absolutely stainless oil is required.

Lubriko Russian Air Compressor Oil will prove its merit in every test.

We also carry many other lines of high-grade oils.

Try our **Lubriko Cup Grease,** the highest melting point cup grease in the world. Also our Emulsive Lard Cutting Oil.

Commercial Oil Co., Ltd., Hamilton, Ont.

COAL

The freight and duty is the same on **high-grade coal** as on medium or low-grade coal.

Our **Lone Star** slack coal is guaranteed to show 14,000 B.T.U.'s regularly.

Our specialty in Canada is high-grade coal from Kentucky and West Virginia via Detroit.

Let us have your inquiries, and call on us if in need of **prompt shipment** via Buffalo, Car Ferry or Detroit.

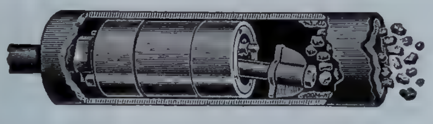
Ohio & Michigan Coal Co., Detroit, Mich.

Dominion Coal Co. Ltd.

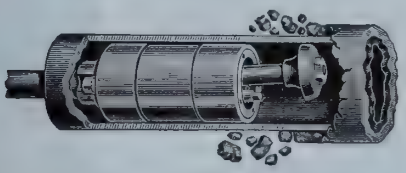
DOMINION COAL COMPANY LIMITED

"Dominion"
and "Springhill" BITUMINOUS
STEAM *and* GAS COALS

GENERAL SALES OFFICE
112 St. James St. Montreal



The Dean removing scale from the tube of a water-tube boiler.



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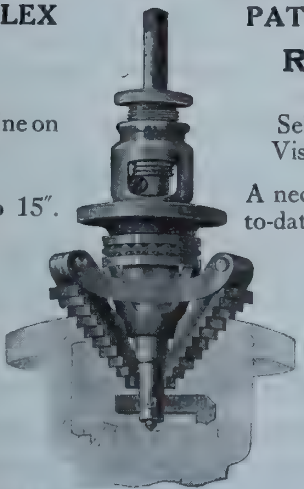

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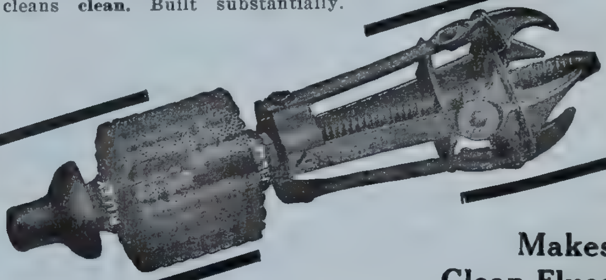

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Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All comunications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

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D. M. MEDCALF,
Chief Inspector of Steam Boilers.

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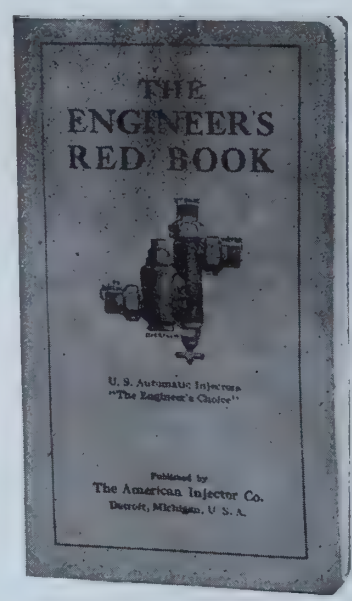

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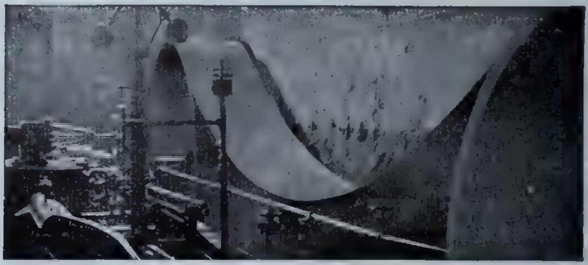

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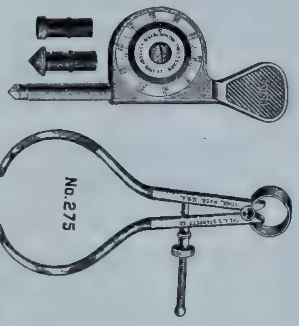

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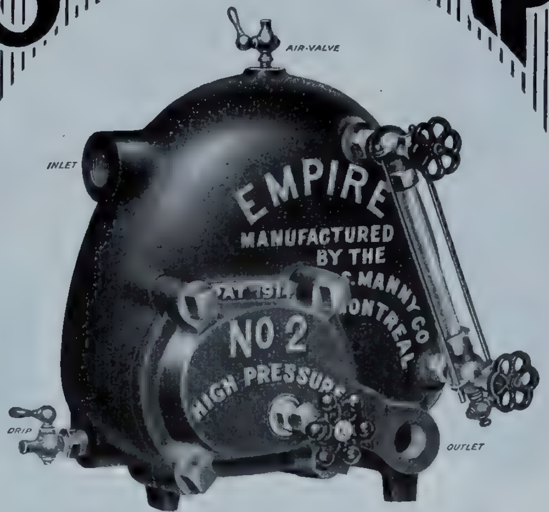

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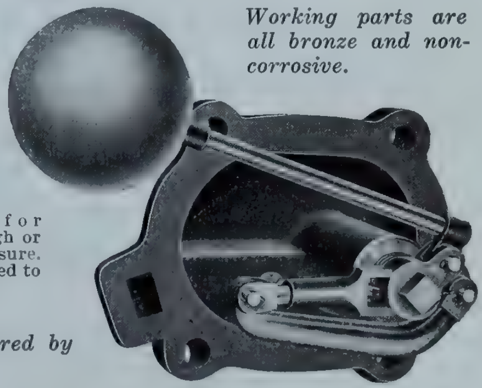

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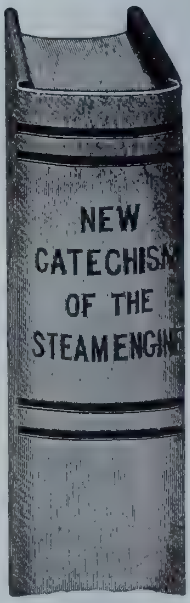

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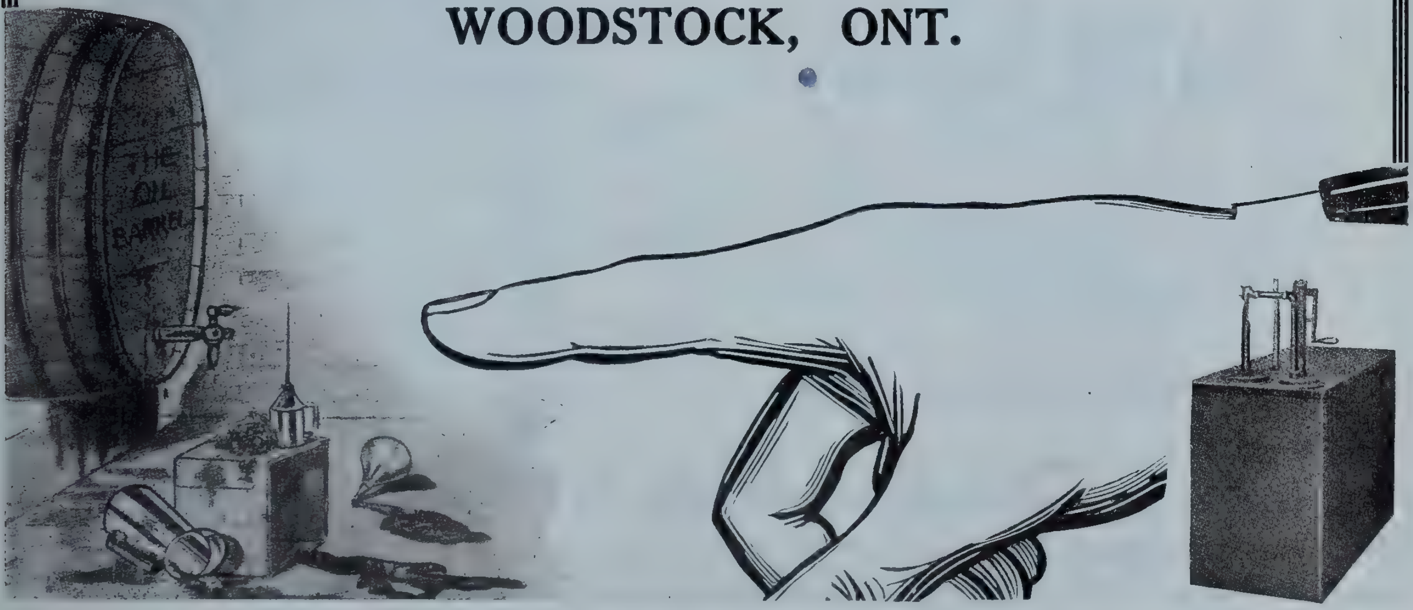

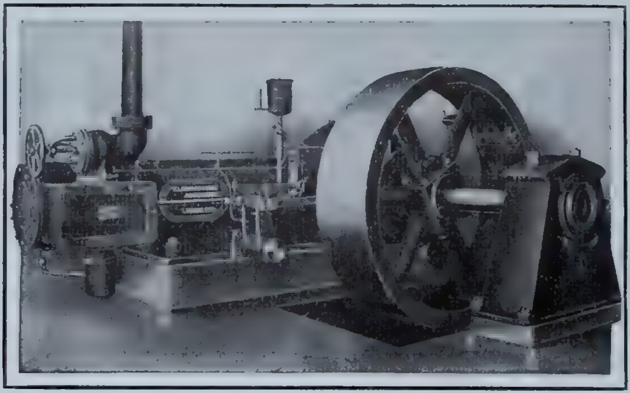

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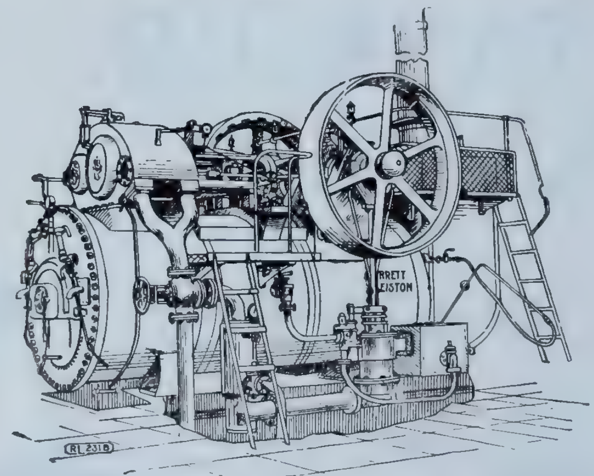

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Dominion Belting Co., Hamilton, Ont.
Federal Engineering Co., Toronto.
Stephenson Mfg. Co., Albany, N.Y.
Graton & Knight Mfg. Co., Montreal.

Belt Lacing, Leather.
Graton & Knight Mfg. Co., Montreal.

Belt Tighteners.
Waterous Engine Wks. Co., Brantford.

Belt Pulleys.
American Pulley Co., Philadelphia.
Dodge Mfg. Co., Toronto.

Belting, Link.
Graton & Knight Mfg. Co., Montreal.
John Millen & Son, Montreal.

Belting, Stitched Cotton Duck.
Can. Consolidated Rubber Co., Ltd., Montreal.
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Belting, Leather.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Dodge Mfg. Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
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Federal Engineering Co., Toronto.
Graton & Knight Mfg. Co., Montreal.
Goodyear Tire & Rubber Co., Toronto.
Main Belting Co., Montreal.
Sadler & Haworth, Montreal.

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Canadian Consolidated Rubber Co., Montreal.
Jeffrey Manufacturing Co., Columbus, Ohio.
Quaker City Rub. Co., Philadelphia.

Belting, Textile.
Federal Engineering Co., Toronto.

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L. S. Davis Co., London, Ont.

Bins, Coal, Coke and Ore.
Jeffrey Manufacturing Co., Columbus, Ohio.

Blocks, Lifting.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

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W. H. Allen, Son & Co., Bedford, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
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Richard Thompson & Co., New York.
Terry Steam Turbine Co., Hartford, Conn.

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Ideal Incinerator Co., Toronto.

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Can. Oil Companies, Ltd., Toronto.
Commercial Oil Co., Hamilton.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dearborn Chemical Co. of Canada, Toronto.
L. S. Davis Co., London, Ont.
Electric Boiler Compound Company, Guelph, Ont.
C. C. Snowdon, Calgary.
Lake Erie Mfg. Co., Inc., Buffalo, N.Y.
Perolin Co. of Canada, Toronto.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
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American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
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Peacock Bros., Montreal.
Smart-Turner Machine Co., Limited, Hamilton.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
Welo Steam Specialty Co., Toronto.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.

Boiler Mountings.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.

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Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
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Polson Iron Works, Toronto.
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Waterous Engine Wks. Co., Brantford.

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Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
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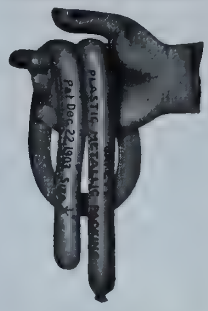

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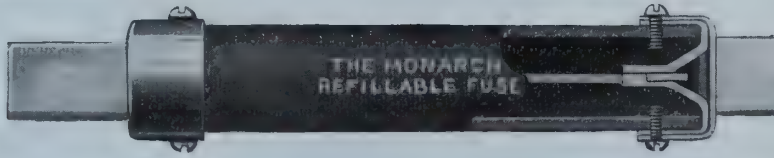

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Round edge hard drawn copper.

Every link stamped with name "Economy" and capacity. Guaranteed to operate as marked.

This venting feature allows no fire to escape, even on severe short circuits.

Washer assembly centres, locks in position and aligns blades.

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Short, active length of element assures uniform performance.

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Northern Electric Co., Ltd., Montreal.
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Northern Electric Co., Ltd., Montreal.

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C. C. Snowdon, Calgary.

Graphitol.
C. C. Snowdon, Calgary.

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Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

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Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
E. S. Manny Co., Montreal.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Heating Engineers.
Theodore Kipp Co., Winnipeg.

Hoists
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Millen & Son, Montreal.

Hoisting and Conveying Machinery
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Inglis Co., Ltd., Toronto.

Hose, Steam, Suction and Water.
L. S. Davis Co., London, Ont.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.

Hydraulic Accumulators.
Can. Allis-Chalmers, Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
W. H. Allen Son & Co., Bedford, Eng.
John Inglis Co., Ltd., Toronto.
John McDougall Caledonian Iron Works, Montreal.

Hydraulic Presses.
Bawden Machine Co., Toronto.

Ice Making Machinery.
Arctic Ice Machine Co., Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co.
Linde British Refrigeration Co., Montreal.
John Inglis Co., Ltd., Toronto.
York Mfg. Co., York. Pa.

Insulators.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Geo. H. Tod, Toronto.
Northern Electric Co., Ltd., Montreal.

Indicators Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Richard Thompson & Co., New York.

Incinerators.
Ideal Incinerator Co., Toronto.

Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
Richard Thompson & Co., New York.

Indicators—Ammonia, Hydraulic.
Can. Detroit Lubricator Co., Walkerville, Ont.

Injectors.
American Injector Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Instruments.
Northern Electric Co., Ltd., Montreal.

Iron Filler.
L. S. Davis Co., London, Ont.

Journal Greases.
Commercial Oil Co., Hamilton.

Lace Leathers.
Graton & Knight Mfg. Co., Montreal.

Lamps, Tungsten, etc.
Canadian General Electric Co., Ltd., Toronto.
Can. Sunbeam Lamp Co., Toronto.
L. S. Davis Co., London, Ont.
Northern Electric Co., Ltd., Montreal.

Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
Federal Engineering Co., Toronto.
P. H. Klein, Jr., Co., Montreal.
Northern Electric Co., Ltd., Montreal.

Leather Strapping.
Graton & Knight Mfg. Co., Montreal.

Lubricants.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.
Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
American Injector Co., Detroit.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

Magnets, Lifting, Generators.
Terry Steam Turbine Co., Hartford, Conn.

Magnetos.
Northern Electric Co., Ltd., Montreal.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Measuring Instruments.
Northern Electric Co., Ltd., Montreal.

Metal Spools.
American Pulley Co., Philadelphia.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton.

Meters, Water.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Mica.
Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
W. H. Allen Son & Co., Bedford,
Can. Fairbanks-Morse Co., Montreal.
Jenckes Machine Co., Sherbrooke, Que
Goldie & McCulloch Co., Galt.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
Bawden Machine Co., Toronto.

Motors.
W. H. Allen Son & Co., Bedford,
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
L. S. Davis Co., London, Ont.

Motor Starters and Controllers.
W. H. Allen Son & Co., Bedford, Eng
Canadian General Electric Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
American Injector Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
S. F. Bowser & Co., Inc., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.
Welo Steam Specialty Co., Toronto.

Oiling Systems.
S. F. Bowser & Co., Inc., Toronto.
Theodore Kipp Co., Winnipeg.
Lunkenheimer Co., Cincinnati, O.

Oils, Lubricating.
Can. Oil Companies, Ltd., Toronto.
C. C. Snowdon, Calgary.

Packing, Engine.
Can. Gasket Co., Bridgeburg, Ont.
Can. H. W. Johns-Manville Co., Toronto.
L. S. Davis Co., London, Ont.
Goodyear Tire & Rubber Co., Toronto.

Packing, Hydraulic.
Goodyear Tire & Rubber Co., Toronto.
Greene, Tweed & Co., New York.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Packing, Metallic.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Goodyear Tire & Rubber Co., Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Sheet.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Goodyear Tire & Rubber Co., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Manville Co., Toronto.
L. S. Davis Co., London, Ont.
Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Goodyear Tire & Rubber Co., Toronto.
Greene, Tweed & Co., New York.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
Graton & Knight Mfg. Co., Montreal.

Patents.
Rowland Brittain, Vancouver, B.C.

Penstocks.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.

Pillow Blocks.
Can. Bond Hanger & Coupling Co., Alexandria.
Elmira Machinery & Transmission Co., Elmira, Ont.

Pipe Coils.
York Mfg. Co., York, Pa.

Pipe Coverings.
L. S. Davis Co., London, Ont.

Pipe Fittings.
International Malleable Iron Co., Guelph.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
Oster Mfg. Co., Cleveland, O.

Pipe Steel.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.

Pipes, Water.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Pacific Coast Pipe Co., Vancouver, B.C.

Piping and Fittings.
Frick Co., Waynesboro, Franklin Co. Pa.
International Malleable Iron Co., Guelph.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.

Planimeters.
Richard Thompson & Co., Toronto.

Plate Work.
Can. Allis-Chalmers, Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

Pneumatic Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Polish, Metal.
G. W. Hoffman, Indianapolis.

Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
American Pulley Co., Philadelphia.
Can. Fairbanks-Morse Co., Montreal.
Dodge Mfg. Co., Toronto.
Elmira Machinery & Transmission Co., Elmira, Ont.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke,
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

Presses.
Bawden Machine Co., Toronto.
John Inglis Co., Ltd., Toronto.

Pulleys.
American Pulley Co., Philadelphia.
Can. Fairbanks-Morse Co., Montreal.
Dodge Mfg. Co., Toronto.
Elmira Machinery and Transmission Co., Elmira, Ont.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pump Leathers.
Graton & Knight Mfg. Co., Montreal.

Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Boving & Co., of Canada, Limited, Toronto.
John Inglis Co., Ltd., Toronto.
Bawden Machine Co., Ltd., Toronto
Can. Allis-Chalmers, Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
W. H. Allen, Son & Co., Bedford, Eng.
Bawden Machine Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
Terry Steam Turbine Co., Hartford, Conn.

Pump Governors and Regulators.
Bawden Machine Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago.

From generator to
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install reliable

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In the largest wire plant in Canada—under the Northern Electric trade-mark and guarantee—is manufactured **every type** of wire and cable, including

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Northern Electric Wires and Cables are the most carefully made—the most rigidly tested—the most universally satisfactory transmission in use to-day. From raw material to finished product the skilled workmanship of our operatives is **continuously** supervised and inspected. Electrical engineers whose reputations have been made on exacting work of great magnitude, use Northern Electric Wire and Cable.

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**Cable Terminals,
Compounds, Junction
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The tests to which all Weston instruments are subjected before leaving the factory, are more severe than actual service ever demand.

Absolute accuracy can be relied on when Weston measuring instruments are used.

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Halifax **Regina** **Vancouver**
Toronto **Calgary** **Victoria**

Elliott Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.
Welo Steam Specialty Co., Toronto.

Pump Strainers.
Bawden Machine Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Contractors'.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Toronto.
William Hamilton Co., Ltd., Peterborough.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Hand and Power.
S. F. Bowser & Co., Inc., Toronto.

Pumps, Centrifugal.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Bromell Patents Co., Ltd., Glasgow, Scotland.
John Inglis Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Works, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
Terry Steam Turbine Co., Hartford, Conn.
Turbine Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Hydraulic, Pressure.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Terry Steam Turbine Co., Hartford, Conn.

Pump Leathers.
Graton & Knight Mfg. Co., Montreal.

Pumps, Oil.
The Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Steam.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
S. F. Bowser & Co., Inc., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Goldie & McCullough Co., Galt.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Triplex.
William Hamilton Co., Ltd., Peterborough.

Pumps, Vacuum.
American Steam Pump Co., Battle Creek, Mich.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
C. A. Dunham Co., Toronto.
John Inglis Co., Ltd., Toronto.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pump Tank, Receiver.
American Steam Pump Co., Battle Creek, Mich.
Can. Allis-Chalmers, Ltd., Toronto.

Pyrometers.
Jas. Morrison Brass Mfg. Co., Toronto.

Rails (Relaying).
Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
Jas. Morrison Brass Mfg. Co., Toronto.

Reboilers
Frick Co., Waynesboro, Franklin Co., Pa.

Recording Instruments.
Northern Electric Co., Ltd., Montreal.
Theodore Kipp Co., Winnipeg.

Reducing Wheels.
Richard Thompson & Co., New York.

Reels.
American Pulley Co., Philadelphia.

Refrigerator Doors, Windows, etc.
Jones Cold Store Door Co., Hagerstown, Md.

Refrigerating Engineers.
Arctic Ice Machine Co., Canton, Ohio.
Chas. Bishop, Montreal.
Can. De La Vergne Co., Limited, Montreal.

Refrigerating Machinery.
Arctic Ice Machine Co., Canton, Ohio.
Can. De La Vergne Co., Limited, Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Theodore Kipp Co., Winnipeg.
Linde British Refrigeration Co., Montreal.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

Refuse Destructors.
Ideal Incinerator Co., Toronto.

Regulators, Pressure.
C. A. Dunham Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.
Richard Thompson & Co., New York.
Welo Steam Specialty Co., Toronto.

Revolving Doors for Hardening Rooms.
Jones Cold Store Door Co., Hagerstown, Md.

Rheostats.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Roofings—Asbestos and Wool Felts.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
L. S. Davis Co., London, Ont.
Federal Engineering Co., Toronto.

Rope Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Rope Preservative.
Cling Surface Co., Buffalo.

Rotary Converters.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Rubber Goods.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Goodyear Tire & Rubber Co., Toronto

Rubber Hose.
L. S. Davis Co., London, Ont.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Quaker City Rubber Co., Philadelphia.

Runways, Hand Operated.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Runways, Electric.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Rubber Molds.
The Bawden Machine Co., Toronto.

Safes.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Safety Valves.
Can. Fairbanks-Morse Co., Montreal.
Lunkenheimer Co., Cincinnati, O.

Sash Pulleys.
American Pulley Co., Philadelphia.

Self-landing, Self-delivery Hoists.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Scale Removers.
William B. Pierce Co., Buffalo, N.Y.

Separators, Oil, Steam and Ammonia.
Frick Co., Waynesboro, Franklin Co., Pa.

Shafting.
Elmira Machinery and Transmission Co., Elmira.
Dodge Mfg. Co., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.

Shaking and Dumping Grates.
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Waterous Engine Wks. Co., Brantford.

Slings.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Smoke Consumers.
Canadian Steam Boiler Equipment Co., Toronto.

Smoke Boxes, Stacks.
Babcock & Wilcox, Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Wks. Co., Brantford.

Smokeless Furnaces.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks., Detroit, Mich.
Geo. H. Tod, Toronto.

Soot Ejectors.
Richard Thompson & Co., New York.

Special Machinery.
W. H. Allen Son & Co., Bedford, Eng.
The Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford.

Speed Indicators.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Sprocket Chain Attachments.
Waterous Engine Wks. Co., Brantford.

Spur Wheels.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford.

Stand Pipes.
John Inglis Co., Ltd., Toronto.

Stand Pipes, Steel.
Can. Allis-Chalmers, Ltd., Toronto.
William Hamilton Co., Ltd., Peterborough.

Stationary Gas Engine Oil.
Commercial Oil Co., Hamilton.

Steam Separators.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.
Arctic Ice Machine Co., Canton, Ohio.
Welo Steam Specialty Co., Toronto.

Steam Specialties.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.
Watson & McDaniel Co., Philadelphia.
Welo Steam Specialty Co., Toronto.

Steam Traps.
V. D. Anderson Co., Cleveland, O.
Can. Fairbanks-Morse Co., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
E. S. Manny Co., Montreal.
Can. Morehead Mfg. Co., Woodstock.
Peacock Bros., Montreal.
H. L. Peiler & Co., Montreal.
Watson & McDaniel Co., Philadelphia
Welo Steam Specialty Co., Toronto.

Steam Turbine Generators.
W. H. Allen Son & Co., Bedford, Eng.

Steam Turbine Pumps.
W. H. Allen, Son & Co., Bedford, Eng.

Steel Tanks.
William Hamilton Co., Ltd., Peterborough.

Stokers.
W. H. Allen, Son & Co., Bedford, Eng.
Detroit Stoker Co., Detroit.
Hare Engineering Co., Toronto.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Theodore Kipp Co., Winnipeg.
Geo. H. Tod, Manning Chambers, Toronto.

Strainers.
W. H. Allen, Son & Co., Bedford, Eng.
Elliott Co., Pittsburg, Pa.

Superheaters, Steam.
Babcock & Wilcox, Montreal.

Switchboards, Light, Telephone and Power.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Lunkenheimer Co., Cincinnati, O.
Northern Electric Co., Ltd., Montreal.

Switches and Switch Boxes.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.
Orenstein-Arthur Koppel Co., Pittsburg.

Tachometers.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Tanks, Blow-off.
Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal.

Tanks, Freezing, Storage and Water Cooling.
Frick Co., Waynesboro, Franklin Co., Pa.

Tanks, Oil.
S. F. Bowser & Co., Inc., Toronto.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.
Wayne Oil Tank Co., Woodstock, Ont.

Tanks, Water.
Can. Allis-Chalmers, Ltd., Toronto.
John Inglis Co., Ltd., Toronto.

Technical Books.
Theo. Audel & Co., New York.
American School of Correspondence, Chicago.

Telephones.
Northern Electric Co., Ltd., Montreal.

Telegraph Systems.
Northern Electric Co., Ltd., Montreal.

Temperature Regulators.
Welo Steam Specialty Co., Toronto.

Thermometers.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Tools; Scraping, Beading.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Track Systems.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Transformers.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.
Northern Electric Co., Ltd., Montreal.

Transmission Machinery.
Can. Fairbanks-Morse Co., Montreal.
Dodge Mfg. Co., Toronto.
Elmira Machinery & Transmission Co., Elmira, Ont.
Goldie & McCulloch Co., Galt, Ont.
John Inglis Co., Ltd., Toronto.
Jeffrey Manufacturing Co., Columbus.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

Trolleys.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Trolley Hoists.
John Millen & Son, Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Trucks.
John Inglis Co., Ltd., Toronto.

Trucks, Factory
Can. Fairbanks-Morse Co., Montreal.

Tube Cleaners.
Can. Allis-Chalmers, Ltd., Toronto.
L. S. Davis Co., London, Ont.
Elliott Co., Pittsburgh, Pa.
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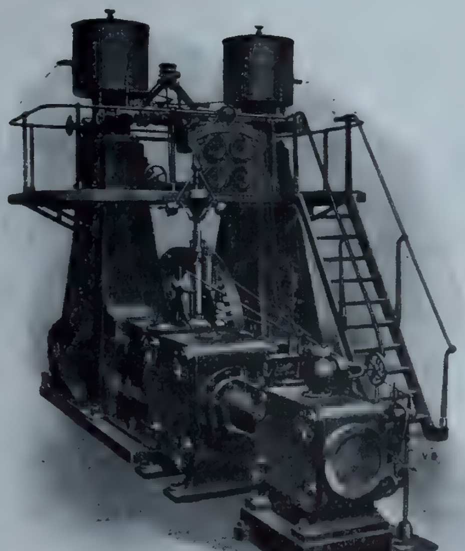

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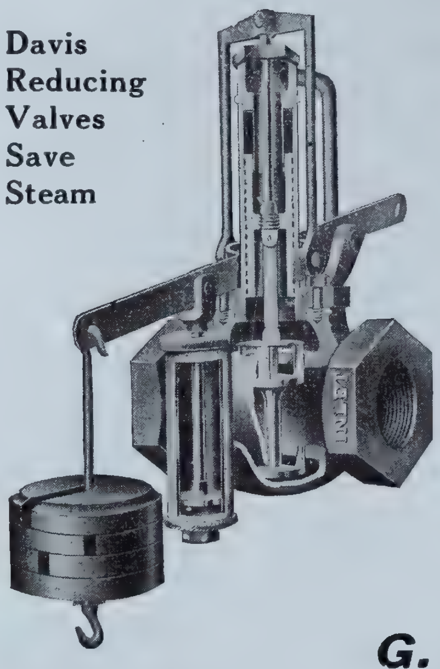

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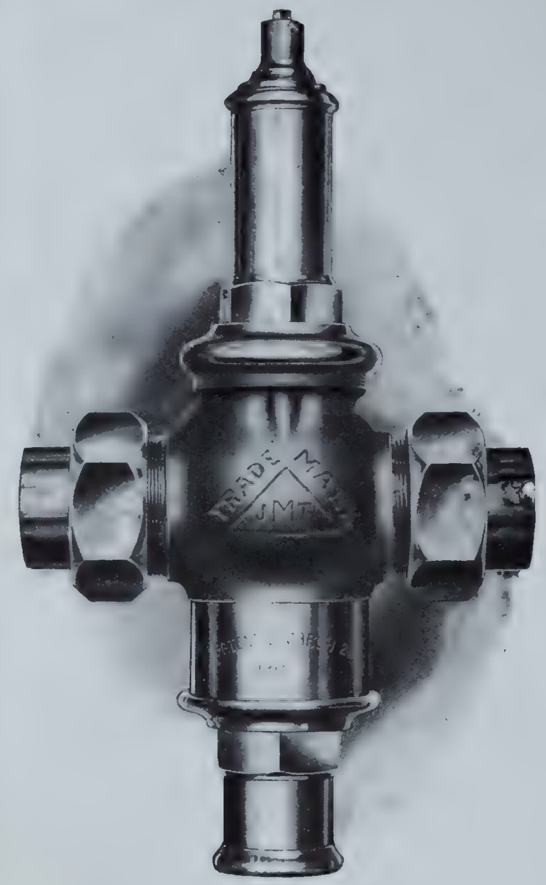

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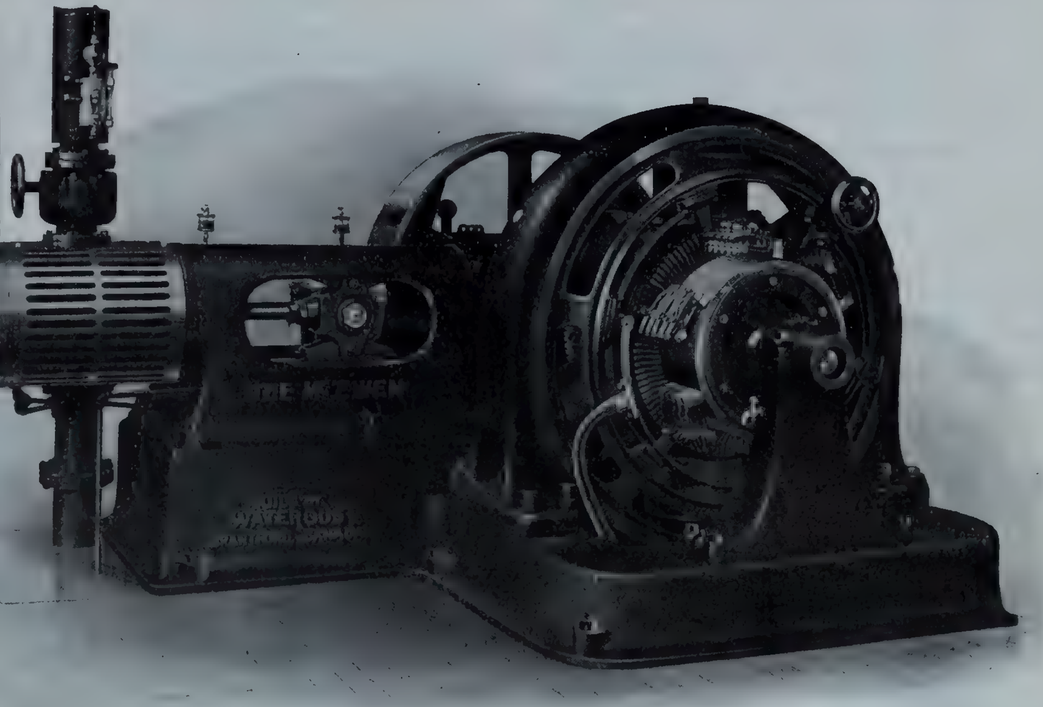

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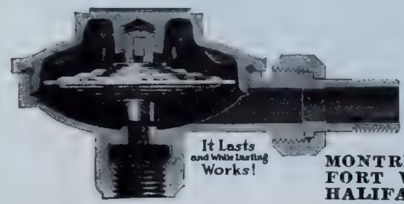

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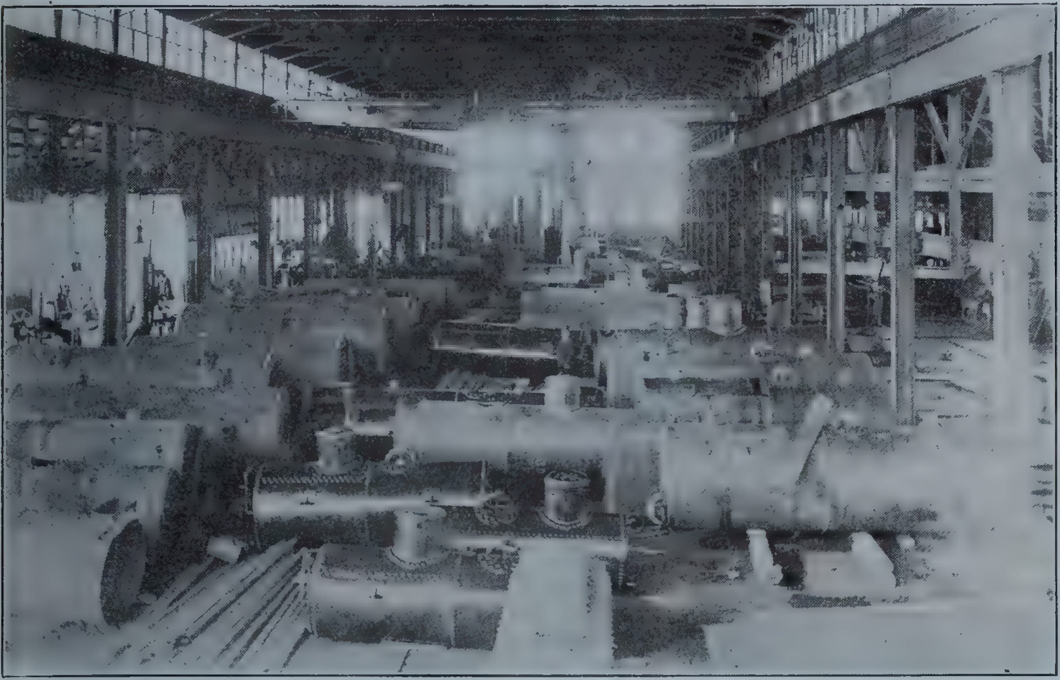

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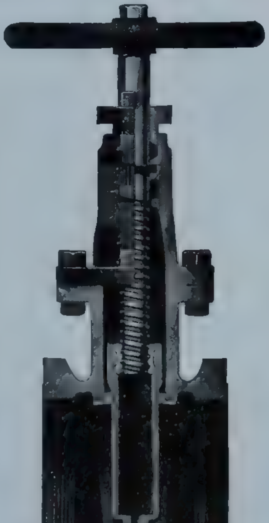

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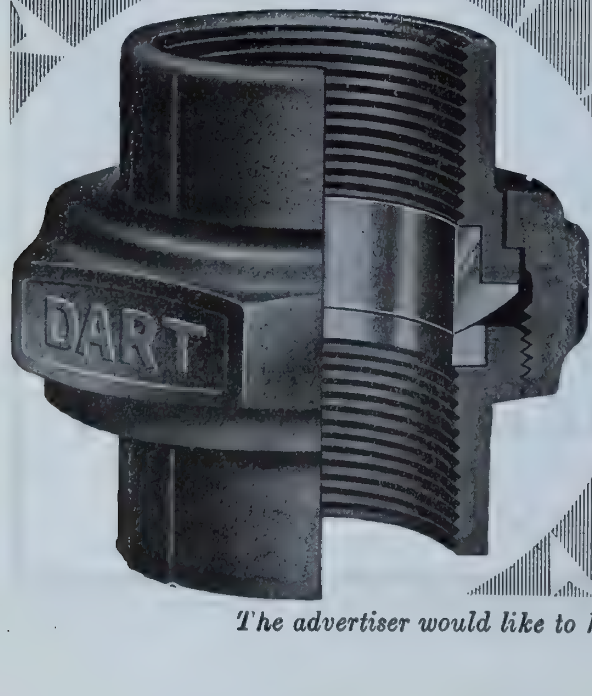

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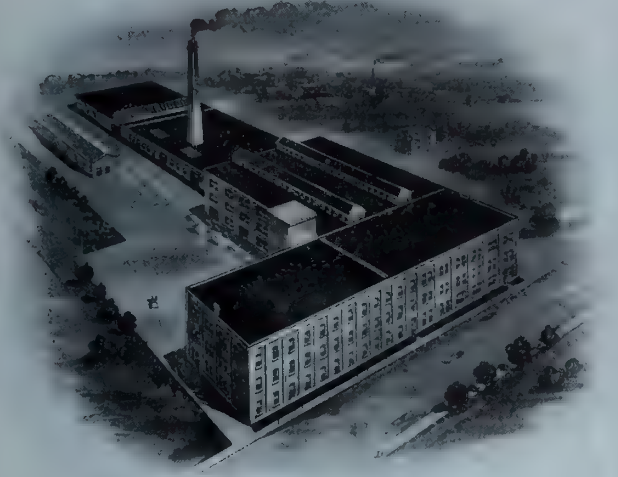

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Hose, Belting, Gauge Glasses, Flue Cleaners, Belt Dressings, Graphite, Waste, Etc.

Some of Our Various Styles

STEAM HIGH PRESSURE

	Style No.
Garlock High Pressure Rings	200
Garlock High Pressure Spiral	150
Garlock High Pressure Diagonal	107
Garlock High Pressure Duo	446
Garlock Valve Stem Twist	117
Garlock Derby Packing..	243
Garlock High Pressure Gaskets	604
Garlock H. P. Jointing...	900

STEAM LOW PRESSURE

	Style No.
Garlock Regular Rings..	7
Garlock Regular Spiral .	6
Garlock Valve Stem Twist	117
Garlock Red Sheet	22
Garlock Diagonal	67

STEAM MEDIUM PRESSURE

	Style No.
Garlock Rings	333
Garlock Extra Spiral	777
Garlock Duo	447
Garlock Ideal	254
Garlock Valve Stem Twist	117
Garlock Red Sheet Style..	22

COLD WATER

	Style No.
Garlock Lake Brand Flax	35
Garlock Square Duck ...	64
Garlock Waterproof Hydraulic	92
Garlock Duo	960
Garlock Mica Frictionless	34
Garlock Red Sheet	22
Garlock Rubber Valves ..	175

HOT WATER

	Style No.
Garlock Special Hydraulic Rings	260
Garlock Fine Hydraulic Coil	262
Garlock Duo	1900
Garlock Red Sheet	22
Garlock High Pressure Jointing	900
Garlock Rubber Pump Valves	108

BRINE AND BEER

	Style No.
Garlock Lake Brand Flax	35
Garlock Waterproof Hydraulic	92
Garlock Red Sheet	22
Garlock Black Sheet	351
Garlock High Pressure Jointing	900

ACID

	Style No.
Garlock Derby Packing..	243
Garlock High Pressure Spiral	150
Garlock High Pressure Jointing	900

GAS

	Style No.
Garlock Extra Ring	333
Garlock Cushion Centre Ring	275
Garlock Red Sheet	22
Garlock High Pressure Jointing	900

OIL

	Style No.
Garlock Ideal Spiral	254
Garlock Waterproof Hydraulic	92
Garlock Oil Proof Sheet.	153

GASOLINE

	Style No.
Garlock Derby	243
Garlock Duo	455
Garlock High Pressure Sheet	900
Garlock Gas Engine Sheet	165

AMMONIA

	Style No.
Garlock Extra Ring	334
Garlock Extra Sec. Ring	337
Garlock High Pressure Jointing	900
Garlock Black Sheet	351

AIR

	Style No.
Garlock Air Compressor Packing	222
Garlock Air Pump	2200
Garlock High Pressure Jointing	900
Garlock Derby Wire Insertion	248
Garlock Red Condenser Valve	152

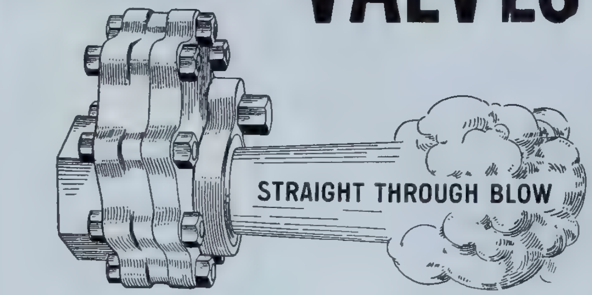
The GARLOCK PACKING COMPANY

Hamilton, Ontario

Montreal Toronto Winnipeg Calgary

Sole Manufacturers, Garlock Packings and Pipe Coverings

EVERLASTING
Blow-Off VALVES



No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 200,000 in use

"EVERLASTING" Blow-Off Valves will **immediately end your blow-off leaks or troubles.**
We guarantee **perfect service.** Any failing to give satisfaction within one year from date of installation will be replaced, or your money refunded if desired.
They have been registered and approved of by the following Provincial Governments: — Ontario, Saskatchewan, Alberta and British Columbia.
Sold strictly on merits — try them.

Look for this MARK☞

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Ltd.

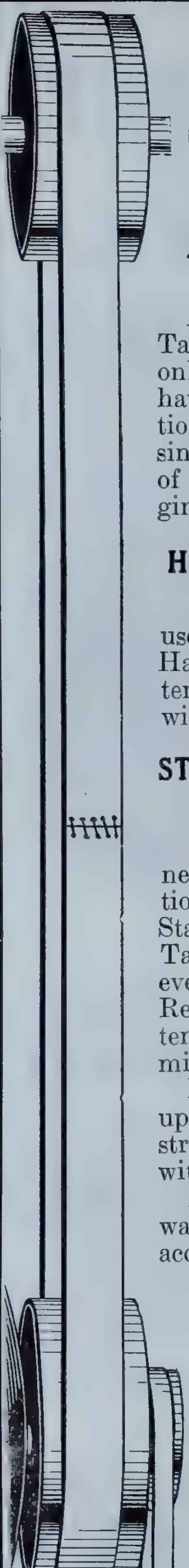
1080 King St. West, Toronto

MONTREAL, QUE.
H. L. Peiler & Co.

CALGARY, ALTA.
P. D. McLaren, Ltd.

VANCOUVER, B.C.
Taylor-Forbes Co., Ltd.

WINNIPEG, MAN.
The A. R. Williams Mach. Co.



SCHAEFFER & BUDENBERG
Tachometers
Are American Made

And as the first manufacturer of Tachometers in this country (and the only one, now) we pride ourselves in having a line of both Hand and Stationary Tachometers that cover every single requirement in the measurement of speeds (R.P.M.) of shaftings, engines, machines, motors, turbines, etc.

HAND TYPE

For portable use our line of Hand Tachometers affords a wide selection.

Hand Tachometer

STATIONARY TYPE

For permanent installations **there is a** Stationary Type Tachometer for every conceivable requirement. The Recording Tachometer furnishes written records of speeds for every single minute, day and night.

Every S. & B. Tachometer is built upon most modern principles of construction, of the finest materials and with the most expert workmanship.

And every S. & B. Tachometer is warranted for long life and constant accuracy.

Send for complete literature To-day. Just ask for Pamphlet W 23.

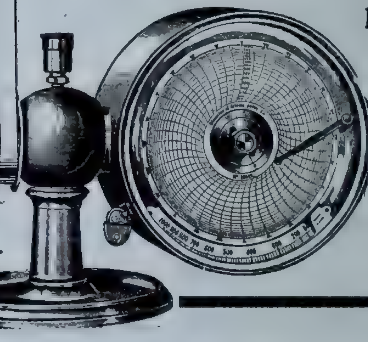
Watch for announcement next month of unique contest in which every Engineer can take part. The prize—An S. & B. Hand Tachometer with complete equipment—our best type, too.

THE
Schaeffer & Budenberg
Mfg. Company

Brooklyn, N.Y.

Chicago

Pittsburgh


A type of Recording Tachometer

MADE IN CANADA

TRADE
JENKINS
MARK

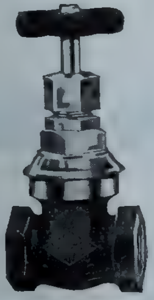


FIG. 300
Type "K"
Brass Gate Valve
Screwed

Jenkins Bros

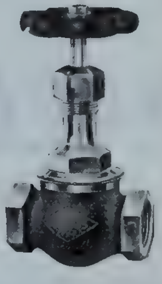


FIG. 106
Standard Pattern
Brass Globe Valve
Screwed

JENKINS BROS.' VALVES

are all well designed, have full opening, and are thoroughly interchangeable, so that any worn or broken part can be readily renewed. They are manufactured by the most modern machinery, from the highest grades of material, so distributed as to give strength and wearing qualities, and each valve is thoroughly tested before leaving our factory.

It is not necessary to shut off steam to pack stuffing-boxes, as by opening them wide, they can be packed under full head of steam.

Look for the Diamond Trade-Mark and Signature which appear only on genuine JENKINS BROS.' VALVES. They guarantee quality and protect the user against inferior imitations.

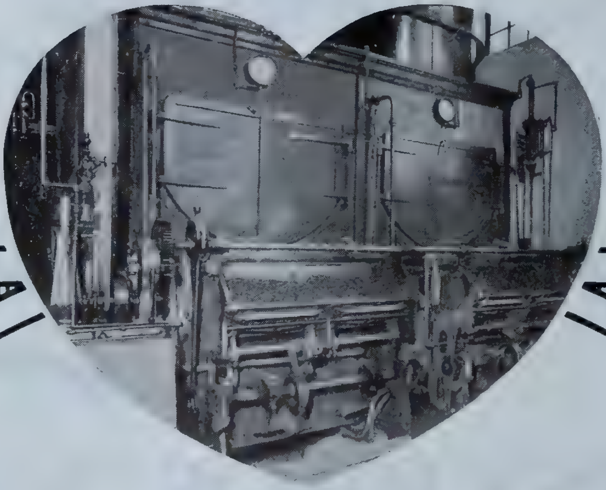
First-class dealers, everywhere, stock
JENKINS BROS.' VALVES

Write for a copy of our Catalogue—It's free.

JENKINS BROS., Limited
103 St. Remi St. MONTREAL

Highest Efficiency

In the Heart of your Plant



is procured and maintained at very small cost through the use of

Potato Scale Boiler Compound

It removes old scale, and a small quantity used daily prevents scale formation, pitting, corrosion, foaming and other boiler troubles due to impurities in the feed water.

It is made to suit feedwater conditions and it contains no ingredients that are injurious to boiler metal or fittings.

Potato Scale Boiler Compound is **saving fuel, boilers and labor,** and keeping boilers at their maximum efficiency FOR THOUSANDS.

Potato Scale Powder is guaranteed to give satisfaction.

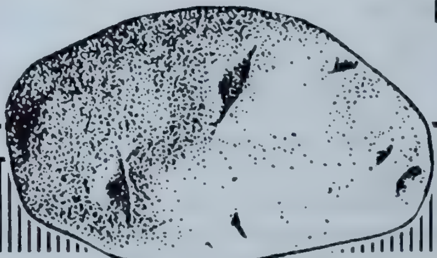
C. C. SNOWDON

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

1810-1840 11th Street E.
Calgary, Alberta, P.O. Box 1384

Branches: Edmonton, Winnipeg, Vancouver



The Quantity of Scale-Forming Matter in Feed Water varies with climatical conditions

This is a reason why **feed water** treatments fall down. They may be compounded to suit one condition and in a few days become useless on account of the increased amount of scale-forming ingredients in the water.

Engineers who use

Perolin

The Boiler Metal Treatment

find it highly effective in loosening scale from the tubes at all times, because PEROLIN **treats the boiler metal**—and boiler metals are universally the same. Although PEROLIN is fed to the boiler in the feed water, the same as feed water treatments, it does not affect the water.

How Perolin Acts

The contraction and expansion cause scale to crack. PEROLIN works through these cracks to the metal—and works along the metal, loosening the scale mechanically, so that it can be readily washed out.

When old scale is thus removed, PEROLIN forms a preservative film over tubes and shell. This film prevents scale-forming substances from adhering to the metal and prevents pitting, corrosion and galvanic action.

The preservative film is an efficient transmitter of heat; it **keeps the boiler up to its full rated capacity,** and as a result it **effects an enormous saving in fuel, boiler repairs and unnecessary work for the engineer.**

Over **30,000 plants** in Canada, United States and Mexico have become **steady** users in the last four years. It's PEROLIN **merit** that does it.

We'll ship you, freight prepaid, a sufficient quantity to test for sixty days.

If not satisfied with the results, return what you have left, and the amount used will cost you nothing.

Perolin Company of Canada, Limited

76 Adelaide Street West **Toronto, Ontario**

Quebec Agents: Burroughs, Joyce & Co., 30 St. John St., Montreal, Que.

Manitoba and Northern Ontario Agents: Engineering & General Supply Co., Ltd., 206 Nanton Bldg., Winnipeg, Man.

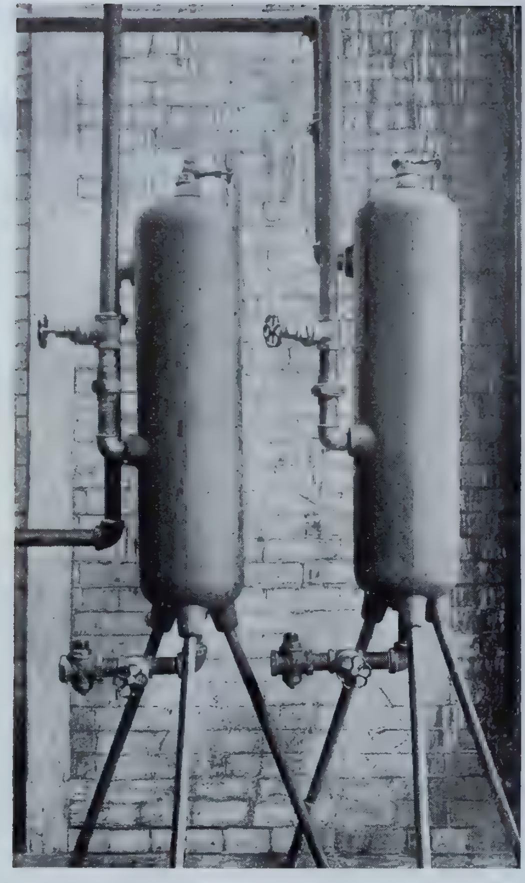
Alberta Agents: The Western Supply & Equipment Co., Ltd., Calgary, Edmonton and Lethbridge, Alta.

British Columbia and Yukon Agents: Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

GUARANTEE

We guarantee PEROLIN, the Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers;
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.



Two Carter Filters Attached to two H.R.T. Boilers.

To All Boiler Users

THE CARTER AUTOMATIC BOILER FILTER AND CLEANER

(Patented and Made in Canada)

Will absolutely prevent Foaming, and the formation of Scale and Mud in your Boiler. Keep it clean, therefore prolonging its life, save its cost in a short time in fuel, lubricating oils, and time spent for repairs and cleaning out boiler.

Not a Chemical, but a Mechanical Device.

COSTS NOTHING TO OPERATE

Sold Only With a Guarantee ☛

What one of the users of the "Carter" has to say:

R. Forbes Company, Limited,
Manufacturers of
Woolen and Worsted Goods
Hespeler, Ont.

Dear Sirs:

This is to certify that after using three of your Automatic Mud Extractors for the past year, we have been quite well satisfied with them, and would ask you to supply four more for the balance of our boilers.

Yours truly,
R. Forbes Co., Limited.

GUARANTEE

The CARTER AUTOMATIC BOILER FILTER and CLEANER is absolutely guaranteed to prevent the formation of scale and foaming and to keep practically all the mud removed from the boiler if operated according to instructions.

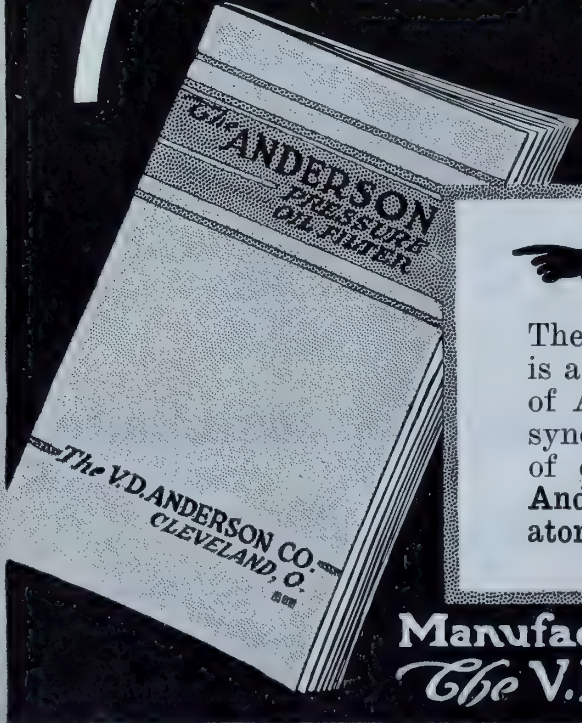
If it does not accomplish what we claim for it, after being in operation for six months we will refund the price paid for it on 30 days' notice.

Write Us for a list of some of the users and copies of their letters.

THE SIEMON COMPANY, Limited

309-11 Confederation Life Building, Toronto, Ont.

The ANDERSON PRESSURE OIL FILTER



The ANDERSON PRESSURE OIL FILTER
The V.D.ANDERSON CO. CLEVELAND, O.

☛ WRITE FOR IT

The Anderson Pressure Oil Filter Catalogue is a brightly illustrated and lucid description of Anderson Oil Filters. It is an educative synopsis of the uses, capacity and structure of our product. Mention is also made of **Anderson Steam Traps, Air Traps, Separators, Water Columns, etc.**

Manufactured by
The V.D.ANDERSON CO. Cleve'd,O.

It costs deadly to neglect your Boilers

It does take time and labor to keep boilers free from scale under the "digging out" method.

"Digging out" is no longer **necessary,** for by placing a small quantity of

Walker's Electric Boiler Compound

in your feed water, the cleaning is done scientifically and with practically no time, labor or cost.

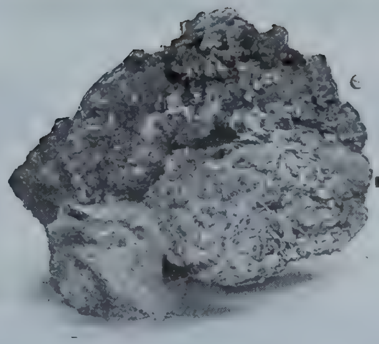
If there is but ONE-EIGHTH inch of scale in your boilers your **fuel waste** ranges from 15 to 25%, and there is more labor for the fireman.

Besides keeping **boilers at full capacity** and fuel bills at a minimum, this boiler compound **prevents pitting, corrosion or other boiler troubles** due to impurities in the feed water.

IT WILL **NOT** INJURE BOILERS, TUBES OR FITTINGS. Nothing enters the composition that is of injurious inclination.

Try a barrel. We guarantee satisfactory results.

The Electric Boiler Compound Co., Limited
GUELPH, ONT.



Does Your Boiler Contain Scale?

The chances are it does!

A great percentage of all boilers in constant use are encrusted with scale from 1/8 to 1/2 inch thick. And new scale is continually forming in most boilers.

"The Southern Engineer," April, 1914, says: "Waste of fuel is usually the immediate effect of an accumulation of scale............Scale causes overheating and the more or less gradual weakening of a boiler.........Scale is recognized the world over as one of the most destructive agencies known in boiler practice......."

J-M BOILER PRESERVATIVE

is the most effective scale remover and scale preventer on the market. Regardless of the condition of the boiler or the chemical constituents of the feed water, this preservative **does remove scale,** no matter how thick or how long encrusted on the boiler plates. It works through the cracks of the scale, practically pries it away from the plates, and breaks it up into small floating particles so that it can be blown out or washed out.

J-M Boiler Preservative prevents new scale from forming, by keeping scale-forming materials separated or in suspension.

It also prevents pitting and corrosion, will not carry over with the steam, nor cause foaming or priming when used according to directions.

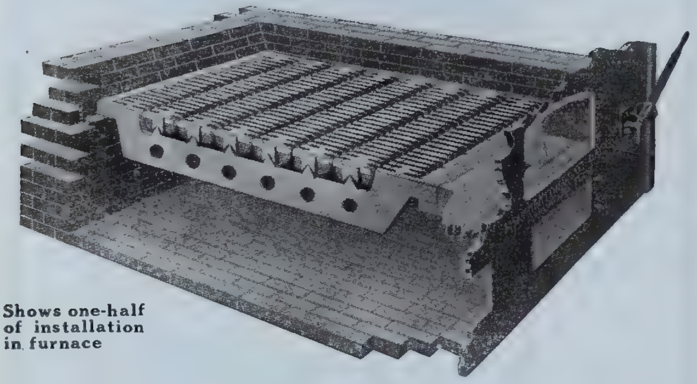
Write our nearest Branch for FREE TRIAL OFFER and Booklet.

THE CANADIAN
H. W. JOHNS-MANVILLE CO., LIMITED
Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Conduit; Metallic Hose; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners; etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

2492

The McNaughton Grate



Shows one-half of installation in furnace

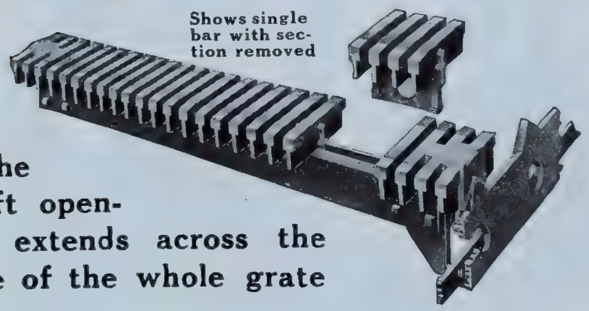
means a saving in fuel, through more efficient combustion, decrease in density of smoke, easier firing and considerable increase in capacity of boilers for overload.

The McNaughton Grate stands up without sagging or buckling, under the most severe test, if given proper care.

REDUCES COST OF UPKEEP FROM 50 to 75% AND ENABLES ONE TO ALWAYS KEEP IT IN FIRST-CLASS CONDITION.

The method of construction makes **repairs easy** and often saves the purchase of an entirely new Bar.

The whole set of Grates and framework is self-contained, and **will fit in where any ordinary grates have been removed.**



Shows single bar with section removed

The draft opening extends across the face of the whole grate

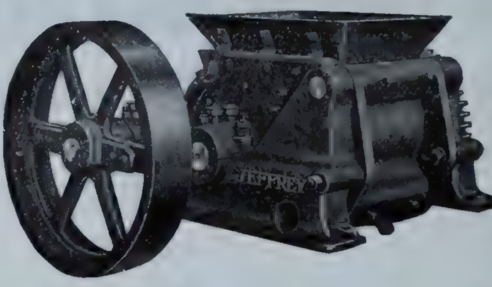
without being closed off or across any place whatever. No other grate could possibly give more draft area and leave any metal to support the fuel. None other can equal it in this respect and not have mechanical disadvantages which only this system of construction entirely overcomes.

There is room for expansion between each section, and no part of the bar is ever under any heat strain.

INSTALLATION ON 30 DAYS' FREE TRIAL. WRITE FOR PARTICULARS.
Ask for Bulletin No. 2

Galt Foundry Company
GALT, ONTARIO

Puts Maximum Efficiency into your Stokers and Furnaces



The Jeffrey Single Roll Crusher

reduces run-of-mine coal into right-sized uniformity, in a single operation; without the use of a feeder; with minimum amount of dust.

It has simplicity, accessibility, durability and wonderful strength of parts; wide range of crushing adjustment.

Built in four sizes, with capacities from 50 to 300 tons per hour.

Write for Crusher Bulletin No. 41-A.

Jeffrey Manufacturing Co.
Canadian Office, Cote and Lagauchetiere Sts., Montreal

SAVE TIME,

MORRIS CHAIN BLOCKS

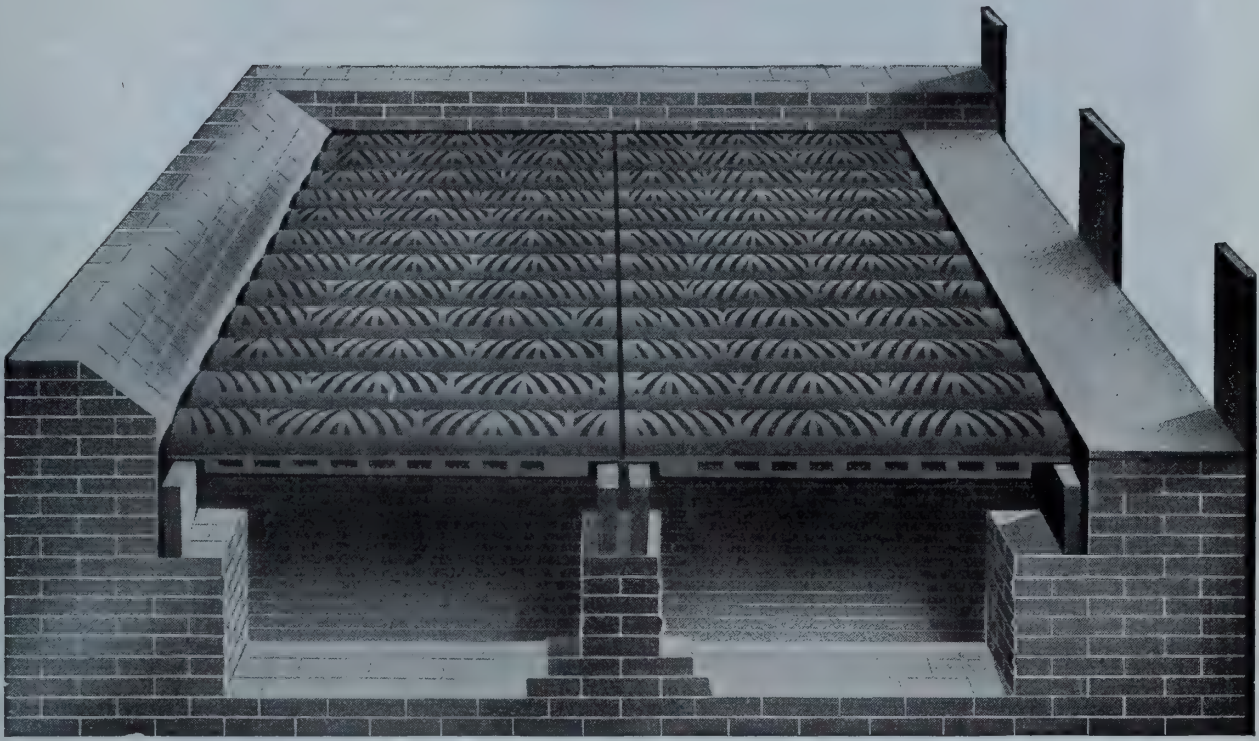
SAVE MONEY.

THE HERBERT MORRIS CRANE & HOIST COMPANY, Limited.
EMPRESS WORKS, PETER STREET, TORONTO.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING — PRESERVE GRATE BARS— PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

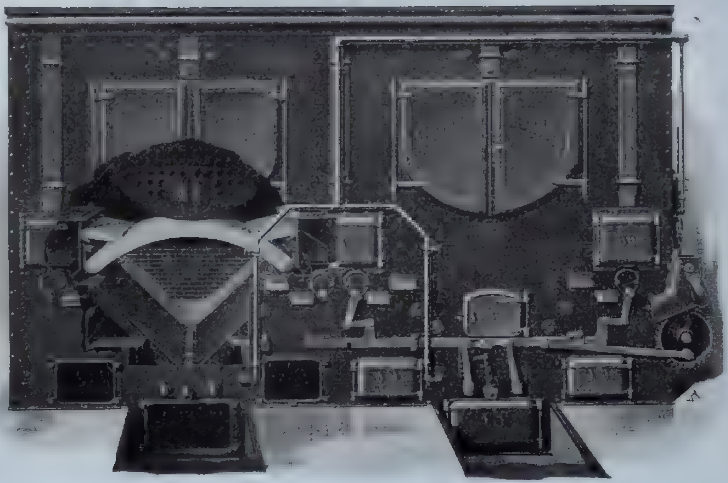
Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., **Birmingham, Ala., U.S.A.**

Murphy Automatic Smokeless Furnaces



The first installation of Murphy Furnaces made for the Provincial Government was for 5 furnaces, in 1913, at the "ONTARIO INSTITUTE FOR THE DEAF AND DUMB," at Belleville. The results so satisfactory as, that in July we obtained contract for 4 300-H.P. units, to be installed in the new power plant at "THE HOSPITAL FOR THE INSANE," at Whitby, Ont.

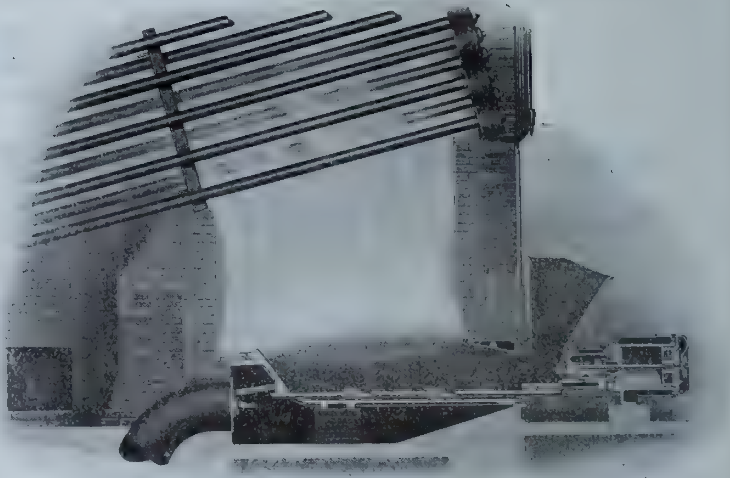
NO OWNER of a steam power plant CAN AFFORD to burn coal under hand-fired conditions!

FOR LIST OF USERS AND CATALOGUE, ADDRESS

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

THE JONES UNDERFEED STOKER

is the simplest stoker built; few parts and none moving in contact with the fire; no grates, no losses through grate bars; no smoke.



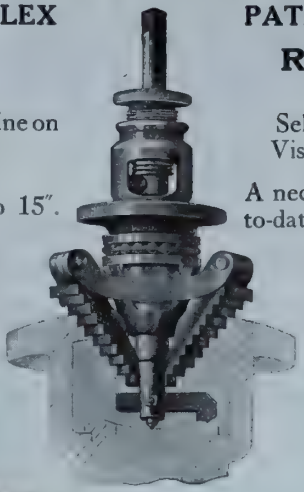
It is a **big** paying investment in the small plant. It is a **bigger** paying investment in the bigger plant. Fuel saving from 15 to 25 per cent. interests you. Hundreds of Jones Stokers are to-day making these savings in plants like your own. Your boiler is no exception. We will put in the **stoker** that will save **you** the coal. Write us.

"Made-in-Canada"

Jones Underfeed Stoker Company, Limited
National Trust Building, Toronto, Ontario

SIMPLEX SPECIALTIES

SIMPLEX PATENT VALVE RESEATER



Simplest Machine on Market.

All Sizes up to 15".

Faces Seats of Boiler Check Valves without Disturbing Pipe Line.

Self-Centering Visible Cutters

A necessity in an up-to-date Power Plant.

Faces Valves with Flat or Angled Seats

SIMPLEX No. 2 SELF-ADJUSTING FLUE CLEANER

GEO. H. TOD	TORONTO
GEO. H. TOD CO.	WINNIPEG
WESTERN SUPPLY & EQUIPMENT CO., Ltd.	CALGARY
W. POOLE DRYER CO., Ltd.	VANCOUVER
MAYSMITH & LOWE Ltd.	VICTORIA

BROMELL PATENTS CO., Ltd., Glasgow, Scotland

SPECIFY MI BRAND

Why Not Buy

Malleable Iron Fittings?

"Made in Canada"

To do so is not only good patriotism but better business. No better can be made, hence no better can be imported.

Our fittings are banded, made of best air refined malleable iron, tapped to gauge, and recessed at time of tapping, thereby ensuring proper and positive reaming. All fittings are full sweep and accurate as to centres.

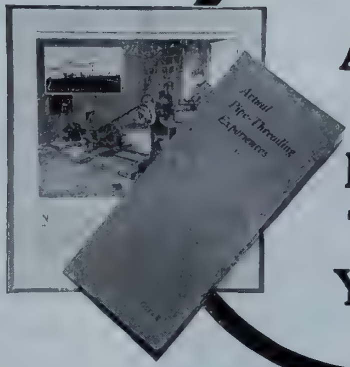
We also manufacture a line of

Recessed Drainage Fittings
as well as
Standard and Extra Heavy
Flanged Fittings.

Our facilities for tapping and galvanizing are the most modern and we solicit your patronage.

International Malleable Iron Co.
LIMITED
Guelph, Ontario

Pipe-Threading Perfection



An Ambitious Aim for More Than Twenty Years

THAT is why these tools *are good.* For more than twenty years this constantly growing organization has concentrated on one single object—PIPE-THREADING tools—and the best possible. These tools are our one consideration; no other product interferes. To-day this group of

OSTER TOOLS

compose the most complete line of pipe-threading equipment on the market. We want each tool to earn for us the good-will and respect of its user, hence we make sure that each tool will make good. The smallest hand die-stock receives the same minute care given the largest machine tool. Many users tell us of their profitable results with these tools. Their experiences make an interest-compelling book which we call "Actual Pipe-Threading Experiences." Write to-day for your free copy. The coupon makes it easy, and your request will have our immediate attention.

29 cities in Canada have Oster Dealers.

THE OSTER MFG. CO.
2099 East 61st Street
Cleveland, Ohio

Kindly send me a free copy of "Actual Pipe-Threading Experiences" by return mail.

Name ....
Company ....
Address ....
City ....
Province 2099

THERE are many methods of steam-raising just as there are many ways of wheat-raising, but there is only one BEST way. The one best way of steam-raising is to fire your boilers by means of "Bennis" machine stokers. You would scarcely attempt to dig by hand your wheat area! It is almost as futile to hand-fire your boilers and expect to raise a good supply of *cheap steam.*

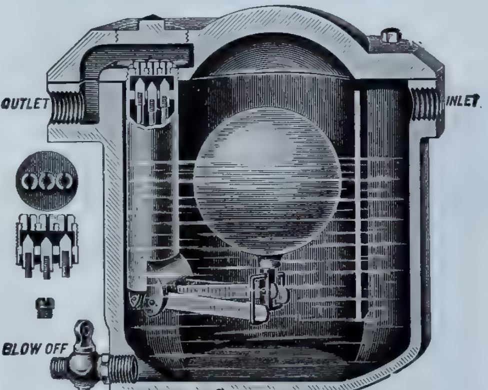
The "Bennis" Long-life Chain Grate Link which eliminates riddling and does not burn off.

"Bennis" Stokers mean cheap steam, and cheap steam means "Bennis" Stokers, and that is the whole of the story. Cheap steam means high boiler duty without smoke from low-grade fuels — *"Bennis" Stokers* mean high boiler duty without smoke from low-grade fuels.

Cheap Steam means a rapid response to a varying load, without detriment to the boiler. "Bennis" stokers mean a rapid response to a varying load, without detriment to the boiler.

Write for ***"Boiler House Economy and Cheap Steam"*** pamphlets and full particulars to

G. H. TOD, 213 Manning Chambers
Queen St. We s
Winnipeg: 601 Union Bank Building
TORONTO



Wright
"Emergency" High Pressure Continual Flow Steam Trap

THREE VALVES

GREAT CAPACITY

Keeps the steam line automatically and continually drained of accumulating condensation.
Shipped subject to trial and return if results are not satisfactory.
Send for Catalog.

DARLING BROS., Limited
15 Ottawa Street, MONTREAL
TORONTO WINNIPEG ST. JOHN, N.B.

LUNKENHEIMER

OIL and GREASE CUPS

Oil Cups.

Grease Cups.

Made in a great variety for all classes of machinery

The large and complete line of Lunkenheimer high-grade engineering specialties also includes Bronze and Iron Body Bronze Mounted Globe, Angle, Cross, Check, Throttle, Gate, Non-return Boiler Stop, Lever, Pop Safety, Relief, Blow-off, Screw-Down Check Valves of all types; Water Columns, Gauges and other Boiler Mountings; Whistles and Ground Key work of all descriptions; Injectors and Ejectors; Lubricators and Lubricating Devices; Oil Pumps, Gasoline Engine Appliances, etc.

Your local dealer can furnish them; if not, write us.

A complete description of the entire line can be had by referring to Lunkenheimer No. 50 catalogue. Write for a copy.

THE LUNKENHEIMER CO.

"QUALITY"

Largest Manufacturers of High-Grade Engineering Specialties in the World

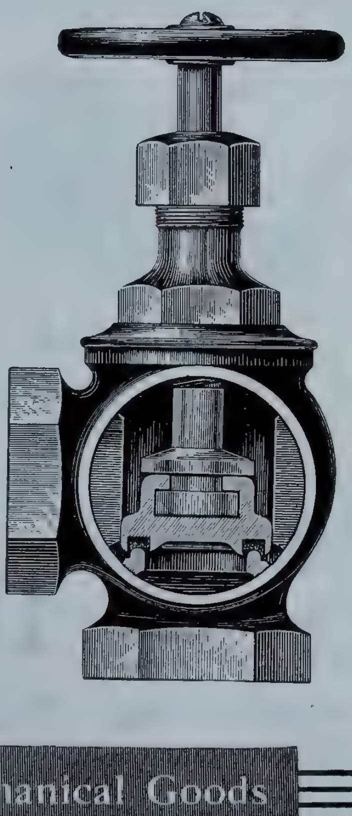
23-43C

CINCINNATI, OHIO

NEW YORK CHICAGO BOSTON LONDON

Worn disc can be replaced by a new one in less than one minute and without any other tool than a wrench to remove the bonnet; not necessary to remove valve from pipe line.

Fairbanks Renewable Disc Valves give the most economical service.



Fairbanks Discs are filled with an asbestos compound which has proved its ability to outlast the ordinary disc many times over. It will not harden under the modern steam pressures. Fairbanks Valves are made of special composition; are designed to stand the roughest work.

Specify "Fairbanks" Valves on your next order.

The Canadian Fairbanks-Morse Co.,

LIMITED

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

Canada's Departmental House for Mechanical Goods

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Hides from the very best of steers

Tanned by the old Genuine British Oak Method are responsible for the distinctive service-giving qualities of

D. K. McLaren's Leather Belting

Genuine Oak

Our (Oak leaf trade-mark) guarantee is on every piece of D. K. McLaren's Leather Belting. Look for it.

This belting will revolutionize your belting costs because of the durability, minimum stretch and positive grip.

It's **used by many of Canada's largest power plants,** the chief engineers of which invariably give it their highest recommendation. Getting power plants acquainted with D. K. McLaren's Belting under actual working conditions, is part of our service. **Let us put you in touch with users—we know their experience will prove invaluable to you.**

VANCOUVER, B.C.
847 Beatty St.

ST. JOHN, N.B.
64 Prince William St.

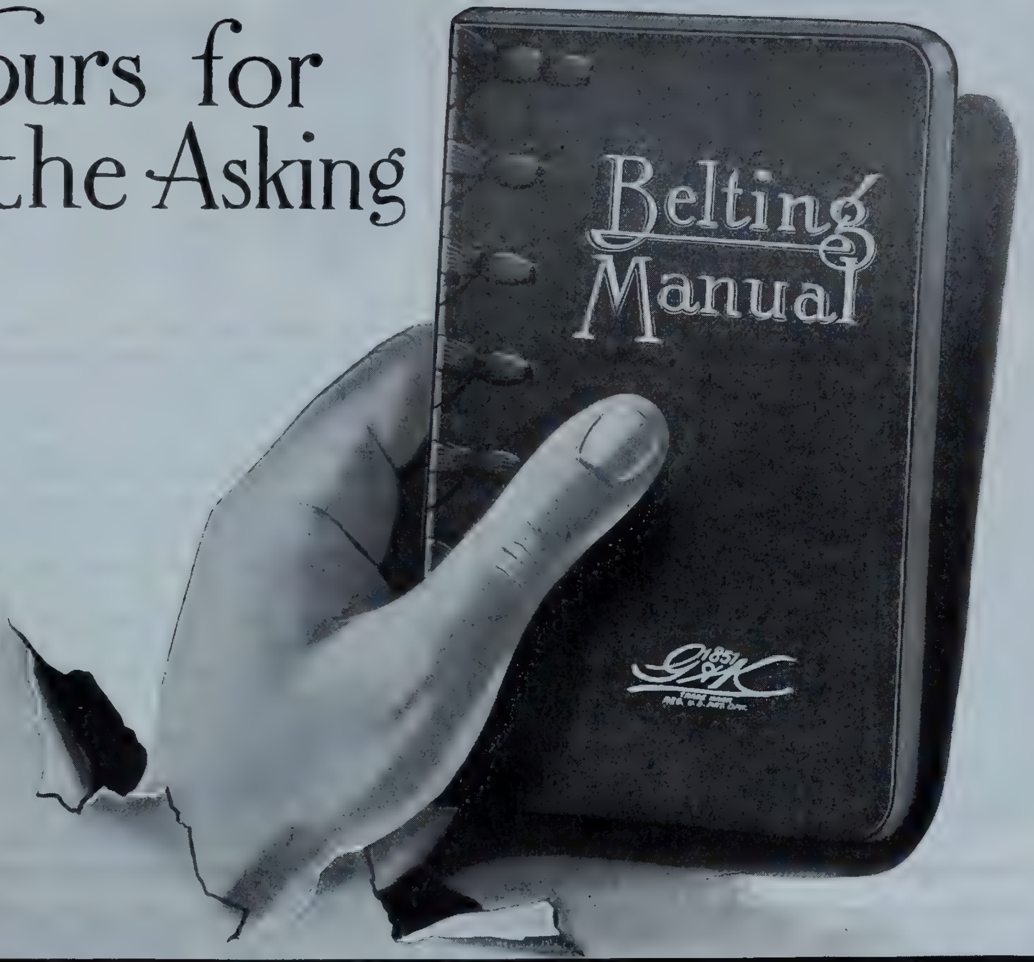
TORONTO, ONT.
200 King St. West

D·K·McLAREN
LIMITED

MONTREAL
351 St. James St.

Engineers' Supply Company
123 Bannatyne Ave. E.
WINNIPEG, MAN.

Yours for the Asking



SHOULD BE IN THE HAND OF EVERY BELT USER

The **"Belting Manual"** gives in a nut-shell all the information you need about Belt Transmission.

It gets right down to rock bottom principles—every one of its 96 pages is a veritable nugget of invaluable information, suggestions, mechanical rules, tables, etc.

In fact, the **"Belting Manual"** is the most complete and authentic book of its kind—a book you cannot afford to be without. You will want to use it every day. Just one little hint may save you hundreds of dollars. Worth while?

Send for a copy and keep it handy for immediate reference. Use the coupon or your letterhead. The book will be sent post-haste and postpaid.

The Graton & Knight Mfg. Company

Oak Leather Tanners and Belt Makers

Unity Bldg., 46 St. Alexander St., Montreal, Que.

Home Office and Factory:

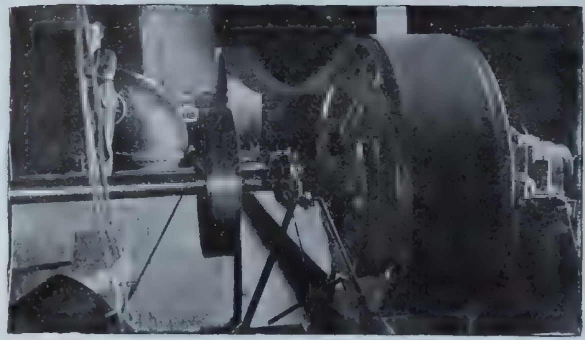
Worcester, Mass., U. S. A.

P.H. 11-14

The Graton & Knight Mfg. Co.
Unity Building, 46 St. Alexander St., Montreal, Que.

Gentlemen:
Send the "Belting Manual" post-haste and postpaid.

Name ....
Address ....
....
Company ....
Position ....
....



27 Cents Per Year for Cling-Surface has kept this 10-inch Double Leather Belt highly efficient in night and day service for over 13 years.

Mr. T. F. Horan, Chief Engineer of Ludlow (Vt.) Electric Lt. & Pr. Plant, speaks as follows about the above and another belt long treated with Cling-Surface:

"Save for the 8 hours we shut down every Sunday, my 10-in. and 12-in. double-ply leather belts have run day and night since April 1st, 1901. They are in the best of condition to-day. Nothing has ever been used on any of my belts but Cling-Surface. No sign of wear whatever, and they sag beautifully. The more load the belts pull, the more they sag, but they never slip."

If your belts are tight, slipping, cracking, running off or wearing out—TELL US. One trial of CLING-SURFACE will immediately make you a Cling-Surface enthusiast. If not, you can have your money back. Send trial order TO-DAY. We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo N Y

77

WHY USE OIL

When GREASE Gives More Uniform Lubrication, Is Better and Much Cheaper?

This Grease Cup will pay for itself many times over with the money it saves in lubricants.

You know that Oil cannot be properly controlled—much of it is lost through dripping.

Grease when used in this Grease Cup is under perfect control until the last drop is used.

The efficiency of this Grease Cup cannot be affected by centrifugal force when used on loose pulleys.

REMEMBER we guarantee it to save 50% over any other system.

Give it a trial and be convinced.

Write for particulars.

Peterborough Machine and Lubricator Co., Limited
Peterborough, Ontario

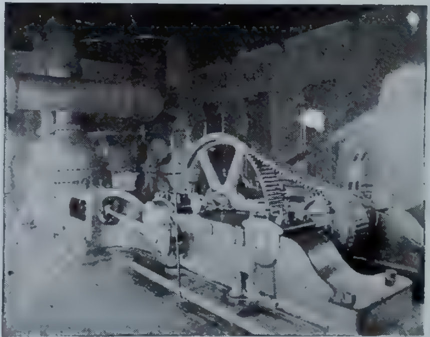
MORSE

In New Hampshire

Where It Pays To "Change to Chains"

THE substitution of Morse Silent Chain Drive in this instance completely stopped disintegration of the building caused by chatter of gearing. The same center distances were used. Full particulars sent on request.

Do YOU not have a gear drive where a chain drive would be more quiet, more efficient, easier on the machine; or, a belt drive where a chain drive would save floor space and eliminate lost power through belt slippage?



Why not give us full particulars and ask for proposition? No obligation attached. Publication Number 12 sent free on request.

SILENT CHAINS

Morse Chain Co. Engineering Dept., B-36 Ithaca, N.Y., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

AMERICAN STEEL SPLIT PULLEYS

At each of
The American Pulley Company's

Warehouses ☞
4200 Wissahickon Ave., Philadelphia.
33 Greene Street, New York.
124 So. Clinton St., Chicago.
165 Pearl Street, Boston.

A dynamometer is standing ready to demonstrate the power required to drive pulleys.

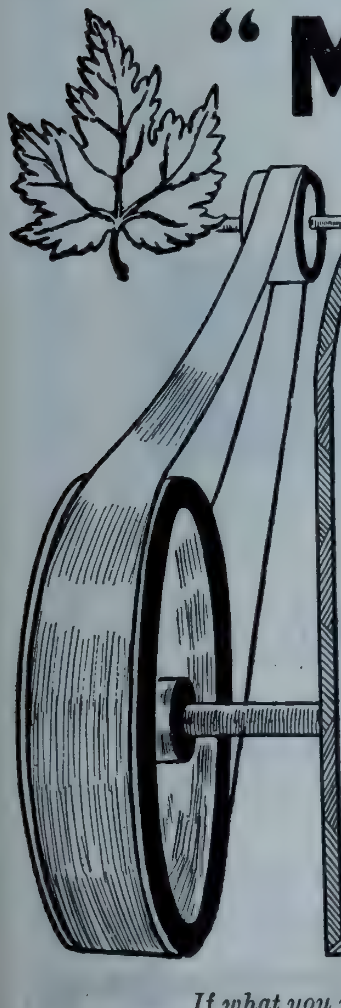
Stop and see the power measured as the pulleys run. Some require from twice to four times as much power as others—size for size.

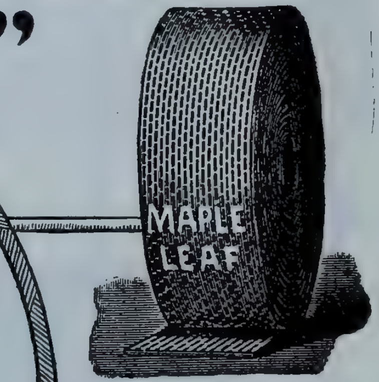
Stocked and sold by dealers.

Large stocks of "American" Steel Split Pulleys are carried at the following warehouses, insuring prompt shipment to customers. CANADIAN DEALERS: Williams & Wilson, Limited, Montreal, Quebec; A. R. Williams Machinery Co., Limited, Toronto, Ont.; St. John, N.B.; Winnipeg, Man.; Calgary, Alberta; Vancouver, B.C.

Made by
THE AMERICAN PULLEY COMPANY

"MAPLE LEAF"





Stitched Cotton Duck Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying. A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

AS USUAL
MAGNOLIA

Gives Entire Satisfaction where "Genuine" and Other Babbitts Fail

JOHN H. WEICHEL
7th Ward Machine Shop.
Dies, Punches and Experimental Work.
130 Green Street.

Lancaster, Pa., Sept. 26, 1913.

Gentlemen:—

I would say that I have used your metal for years, and as I have been working at general repairing of machinery for forty-five years, you can see that I have had some experience in my line. Two years ago I rebabbitted a bearing on a Corliss Steam Engine—125 H.P. The Shaft being worn out of round, it became hot enough to melt out the babbitt; the proprietor of the works instructed me to use nothing but Genuine Babbitt at 50 cents lb.; I did so, and in two weeks' time, I had to replace it with Magnolia and it is running every day since with shaft out of true.

Yours truly,

JOHN H. WEICHEL, Sr.

Sold by Leading Dealers Everywhere or by

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

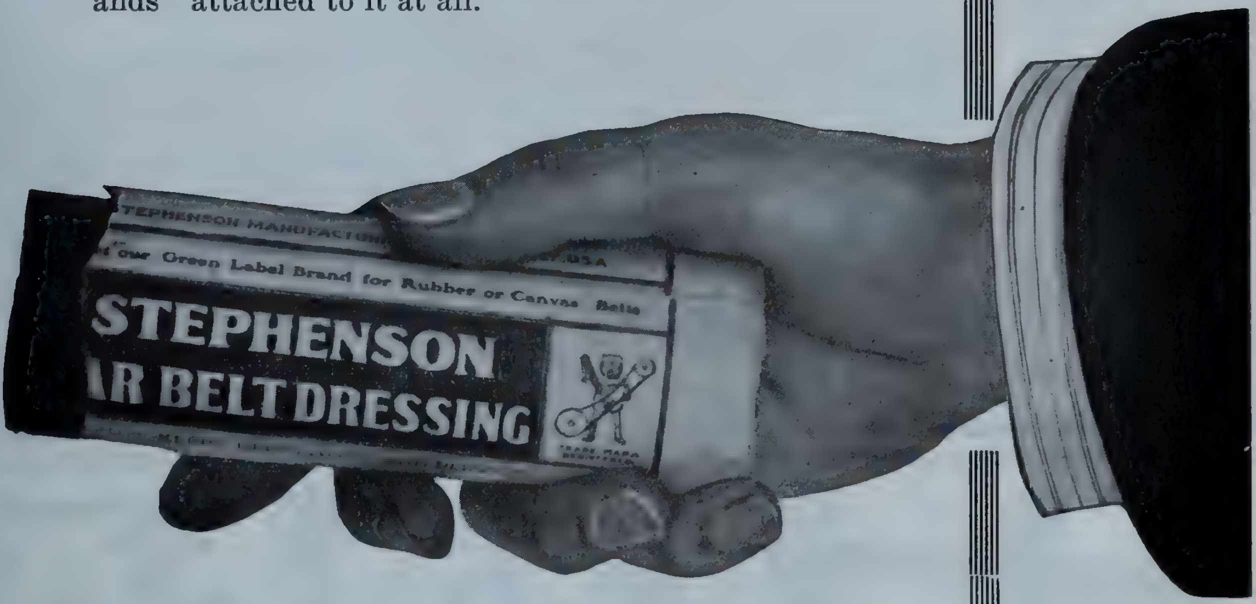
225 St. Ambroise St. MONTREAL

UNLESS THE WAR PREVENTS

We expect to receive from England, in December next, the 1915 issue of the PRACTICAL ENGINEER POCKET BOOK: Price as usual, 40c post paid.

We'll send this ½ lb. Bar for your Free Trial

This sample is **absolutely** free—no "ifs" and "ands" attached to it at all.



We know that it is a wonderful worker—the finest thing for belts and the easiest applied, and we are giving you this opportunity to get acquainted.

CUT OUT COUPON AND MAIL IT TO-DAY.

Ask your helper to step into the office now and get an envelope. You cannot afford to miss this opportunity to try something really good at no expense.

Stephenson Manufacturing Co.

Albany, N.Y.

Stephenson Mfg. Co., Albany, N.Y.
Gentlemen: Kindly send me free of charge a
half-pound sample of your belt dressing.
Name ....
Firm ....
Address ....

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

The "Monarch" Refillable Fuse

MONARCH REFILLABLE FUSE
A Sure Contact

Knife Blade Type with one end cut away to disclose the method of forming, the contact between the fuse ribbon and the blade.

The Monarch Refillable Fuse is constructed with all parts Die Stamped, making the parts accurate and interchangeable, thereby making the **refilling very simple**, as the different parts will fit either cap. Our **Spring Gripping** contacts are made of copper, assuring proper carrying capacity and cooling surface.

When you buy Monarch Refillable fuses you get **efficiency**, **reasonable price** and **prompt shipment.**

Write for circular giving full description.

The Monarch Refillable Fuse Co., Ltd., Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

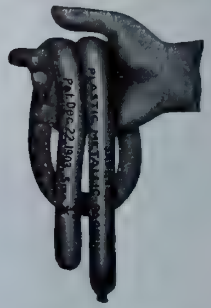
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

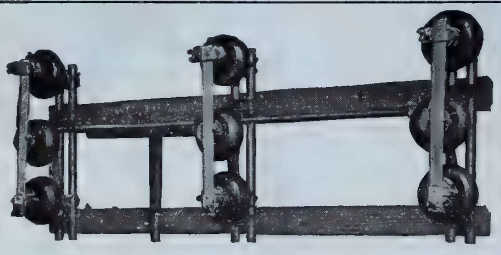
Manufactured only by

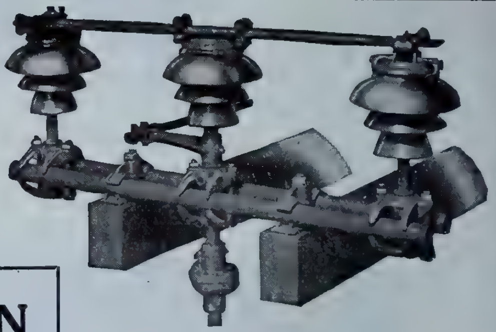
STEEL MILL PACKING CO., WINDSOR, ONT.

Practically Frictionless



Any Quantity sent on APPROVAL





SATISFACTION

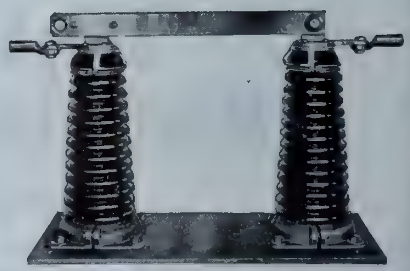
guaranteed does not mean much until you have tried our specialties. We have many satisfied customers, let us put **your** name on our list.

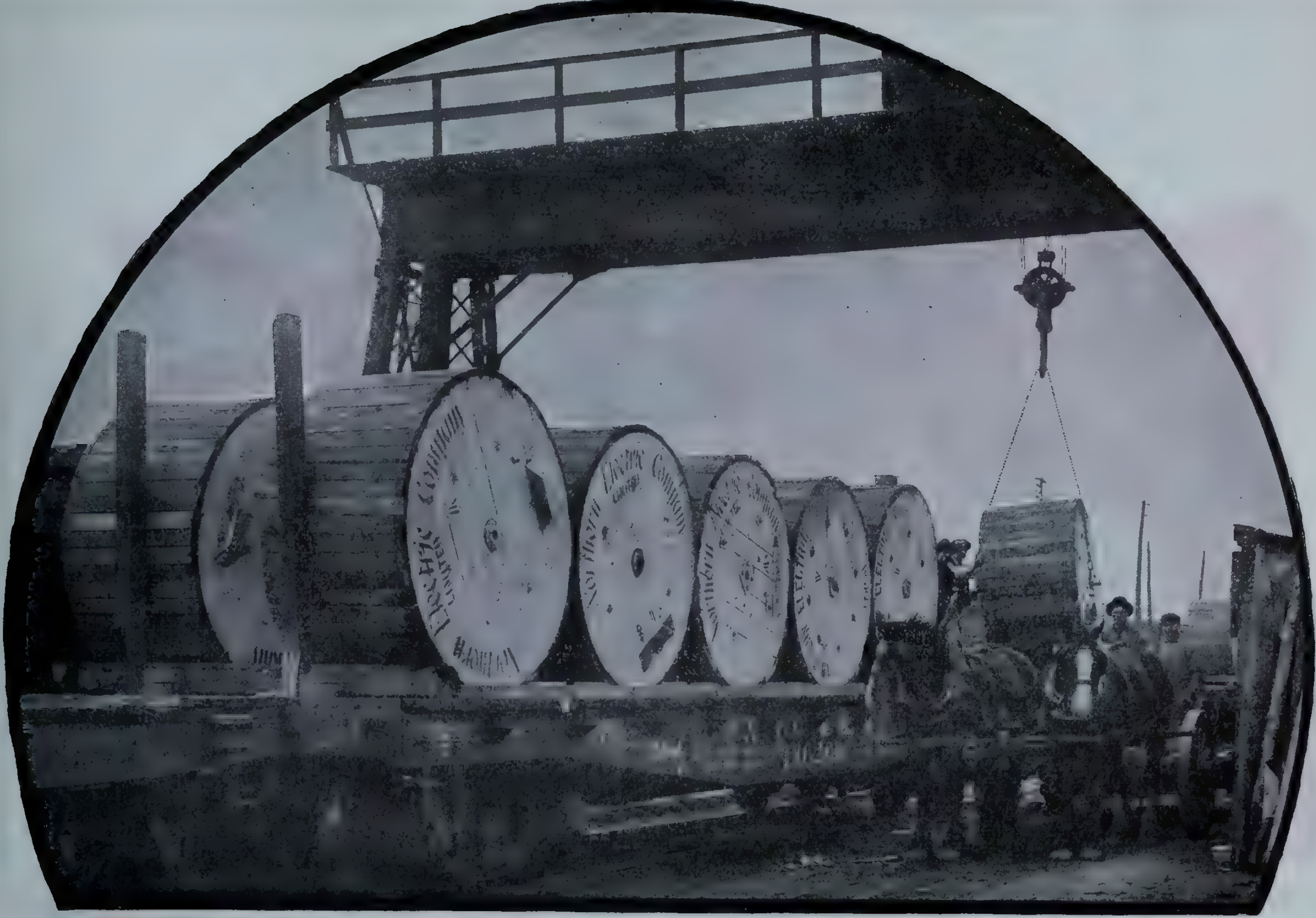
Write for Bulletin No. 102 covering reduced prices and new types of Cable End Bells.

Northern Electric Company
LIMITED

Montreal Halifax Toronto Winnipeg Regina
Calgary Edmonton Vancouver Victoria

WIRES & CABLES
Northern Electric Company LIMITED
FIRE ALARMS TELEPHONES SUPPLIES





Just a Part of One Order for

Northern Electric

High-Tension, Lead-Covered, Paper-Insulated

POWER CABLES

IT took 17 freight cars like the one illustrated to ship this complete order to the Cedar Rapids Manufacturing and Power Company's new generating station at Cedar Rapids, Que.

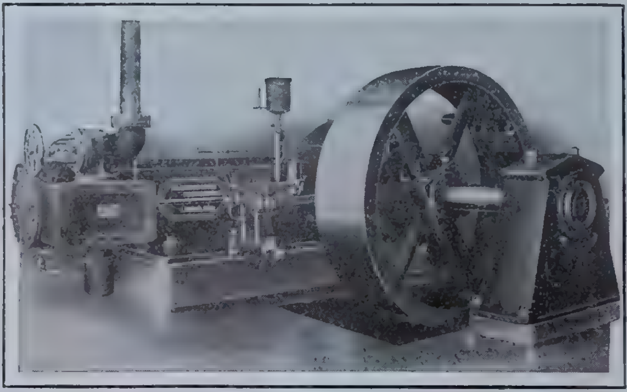
¶ It pays to place your orders with a Company that gives quality based on knowledge gained through long manufacturing experience.

¶ It pays to deal with a Company that has the greatest facilities for the prompt handling of orders for every kind of wire and cable used in the electrical industry.

¶ It pays to place your orders with the Company that has the confidence of the Central Station men as well as the most prominent members of the engineering profession.

Northern Electric Company
LIMITED

MONTREAL HALIFAX TORONTO WINNIPEG REGINA
CALGARY EDMONTON VANCOUVER VICTORIA



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

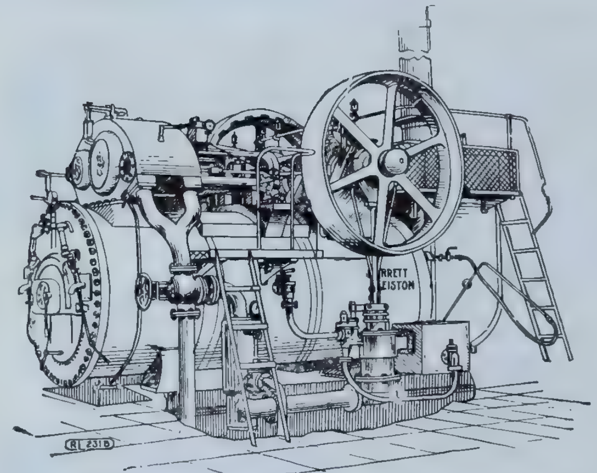
High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

STEAM ENGINES

With Gas Producer Economy **Steam Engine Reliability**



THE GARRETT (SUPERHEATED STEAM SEMI-STATIONARY) ENGINE.

Require only 1¼ Lbs. OF COAL PER B. H. P. HOUR.

Sizes 40 H.P. to 250 H.P.

Can use any kind of fuel Anthracite, Bituminous, Lignite, Wood, Shavings, Sawdust, Oil or Gas.

Just the Power for the Small Town.

Electric Light or Pumping Plants.

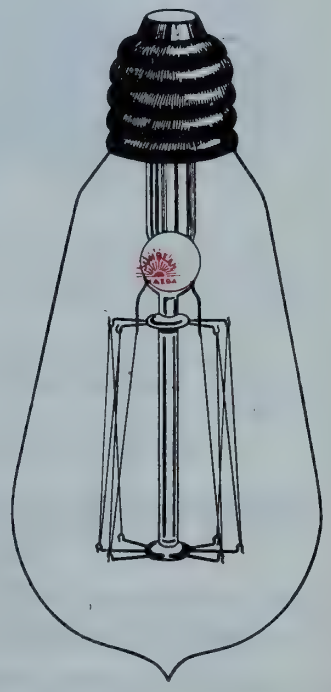
Mills or Factories.

Efficient, Reliable, Economical.

Correspondence Solicited.

Theodore Kipp Company

Union Trust Building **Winnipeg, Manitoba**



Sunbeam Mazda Lamps

Made under the Canadian Flag

When you buy from us, you get lamps that are cheaper, quality considered, than any imported makes, and you keep Canadian money in Canada for the benefit of Canadians.

Sunbeam Mazda Lamps save money not only on account of their durability, but on account of the fact that they give THREE TIMES AS MUCH LIGHT AS THE CARBON LAMP AT THE SAME CURRENT CONSUMPTION.

Let the lamps themselves prove their quality. Try them.

We ship quickly and guarantee satisfaction.

The Canadian Sunbeam Lamp Co.
LIMITED
Main Office and Factory: TORONTO, CANADA
Branch Warehouses: Montreal, Winnipeg, Calgary, Vancouver

REFRIGERATION DEPARTMENT

Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

Bulletins sent on request.

The Vilter Mfg. Co.
242 Becher St. Milwaukee, Wis.

DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration. De La Vergne machines have been installed in all parts of the world.

We have been building refrigerating machinery for thirty years and **many of our machines installed over twenty years ago are to-day maintaining their high initial performance.**

Our long experience in this particular work enables us to furnish the best design equipment.

We are prepared to furnish everything in the refrigerating line for Breweries, Cold Storage Plants, Packing Houses, Skating Rinks, Ice Plants (distilled or raw water systems), etc.

The name **De La Vergne** stands for **highest quality, maximum capacity, absolute reliability and permanent economy.**

Send for bulletin No. 1310

CANADIAN DE LA VERGNE COMPANY
LIMITED

304-306 University St.,
MONTREAL, Canada

95 King St.,
TORONTO, Canada

Plant of the York Manufacturing Co.

Devoted exclusively to the manufacture of Ice-Making and Refrigerating Machinery and Supplies.

The World's Largest Ice Machine Plant

IN AREA—over 15 acres in extent.
IN OUTPUT—647 YORK Machines, having a total refrigerating capacity of 13,645 tons per 24 hours, were shipped in 1913.
IN NUMBER OF EMPLOYEES—over 2,000 men are employed in the manufacture, sale, and in superintending the erection of YORK products.

Consult us in regard to your Refrigerating Requirements.

York Manufacturing Company, York, Pa., U.S.A.

Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

MONTREAL, 324 Coristine Building **TORONTO, 163-167 Yonge Street** **WINNIPEG, 302 Donalda Building**

J. V. Jamison, Pres. **T. B. South, Vice-Pres.** **J. V. Jamison, Jr., Sec. & Treas.** **R. L. Jamison, Order & Ship. Dep't.**

Cold Storage and Freezer Doors either Standard or Fireproof

DOORS

"Jones" Standard Automatic Track Door, Left Hand.

The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones'." Built for strength and durability.

We have a 68-page profusely illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

The "Jones" Cold Storage Window.
The "Jones" Automatic Ice Recording Doors and Chutes.
The "Jones" Platform Ice Passing Chute and Door combined.
The "Noequal" All Steel Automatic Ice Chute.
The "Noequal" Revolving Ice Cream Passing Door (Wood or Steel)
The "Jones" Vertical Sliding Door.

JAMISON COLD STORAGE DOOR CO.

FORMERLY

JONES COLD STORE DOOR CO.

HAGERSTOWN - MARYLAND, U.S.A.

Worth
Your
Study

ARCTIC ICE
MACHINERY

The Ammonia Compressor guaranteed to produce 20% over-capacity as compared with any other Horizontal ice machine of equal size on earth—it's a mighty interesting proposition. Bulletin 1-P explains the construction.

ARCTIC-POWNALL
RAW WATER ICE PLANTS

Are causing orders and inquiries from all parts of the world—and the sparkling purity and freedom from taste or odor of this ice deserve the popularity it has achieved. Ask for full particulars.

"WE DO IT RIGHT."

THE ARCTIC ICE MACHINE CO.
CANTON, OHIO, U.S.A.

THE
H&C
SAFETY

The Largest Ice Dealer in Detroit Installed Two H. & C. Safetys a Year Ago.

Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of 6 3-10 K.W. **per ton or more than 11½% saving in power consumption.**

You, Mr. Iceman, should check up on your costs and capacity against these records.

Write us to-day for a Pittmans & Dean chart of their year's results.

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Refrigerating and Ice-Making Machinery
DETROIT 42nd Year. MICHIGAN

MADE IN CANADA
WATER TURBINES
CENTRIFUGAL PUMPS
PULP AND PAPER MACHINERY

Patronize Home Industry and Let
Us Quote on Your Requirements.

Boving & Co. of Canada, Limited

94 Grafton Ave.,
Moose Jaw, Sask.

Head Office:
164 Bay Street, Toronto

London Bldg.,
Vancouver, B.C.

Factory at Lindsay, Ont.

Mexico City, Wellington, Cairo, London, Eng., Tokyo, Johannesburg, Rio de Janeiro

USE THE BEST

ANHYDROUS AMMONIA "EXCELSIOR" BRAND

100% EFFICIENCY

MANUFACTURED ONLY BY

Canadian Ammonia Co., Ltd.

TORONTO, ONT. DETROIT, MICH.

STOCK CARRIED IN ALL
PRINCIPAL CITIES IN CANADA

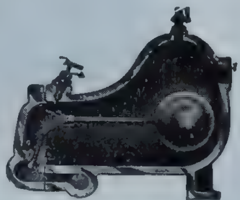
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

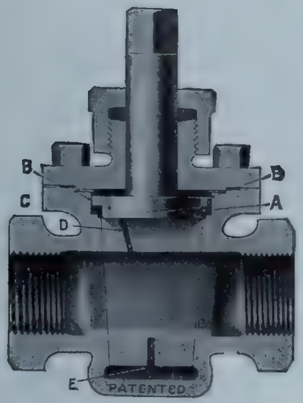
Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.
WATSON & McDANIEL CO.,
No. 146 N. 7th St. PHILADELPHIA, Pa.



A Guaranteed Valve

For Every Purpose

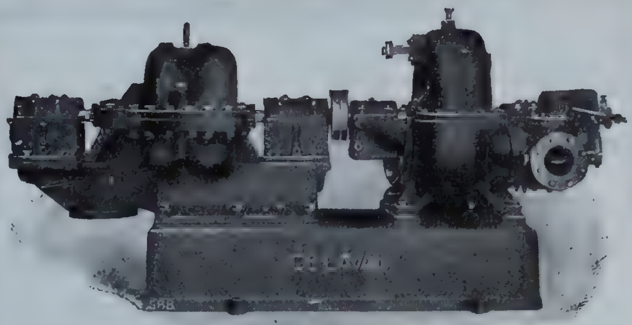
Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

Send for Catalog "R."

Homestead Valve Mfg. Co.
Works: Homestead, Pa. Pittsburgh, Pa.



THE NEW DE LAVAL

Class "C" Turbine

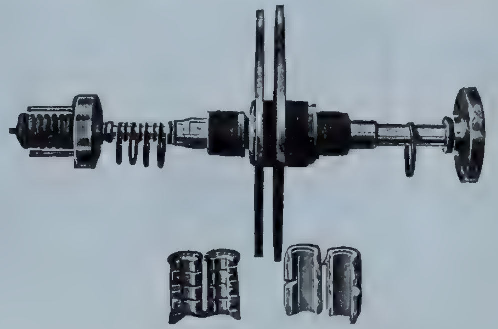
Is Unequaled for Driving Auxiliaries

IT is exceptionally simple in construction, the rotating parts consisting only of a shaft, two or three wheels and the governor.

All internal working parts are exposed upon lifting the casing cover, which can be done without disturbing the steam or exhaust connections.

After removing the bearing caps, the entire rotating member may be taken out of the turbine for examination or repair.

The buckets and guide vanes are of drop-forged nickel bronze and are non-corrodible and give the longest possible life.



Complete rotating member and bearings of De Laval Class "C" Turbine removed from casing.

The efficiency of these turbines is high, which, coupled with their ruggedness and simplicity, makes them the ideal turbines for driving Centrifugal Pumps, Blowers, Generators, etc.

Send for catalog C-61

DE LAVAL STEAM TURBINE CO.

Trenton 76 New Jersey

Turbine Equipment Co., Ltd.
Canadian Pacific Bldg. Toronto, Canada

MESSRS. TAYLOR & YOUNG,
513 Pacific Bldg. - - - - - Vancouver, B.C.
THE E. LAURIE COMPANY.
243 Bleury Street - - - - Montreal, Quebec.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Polson Marine and Land Boilers

have that reputation throughout Canada which can only be secured by many years of successful building.

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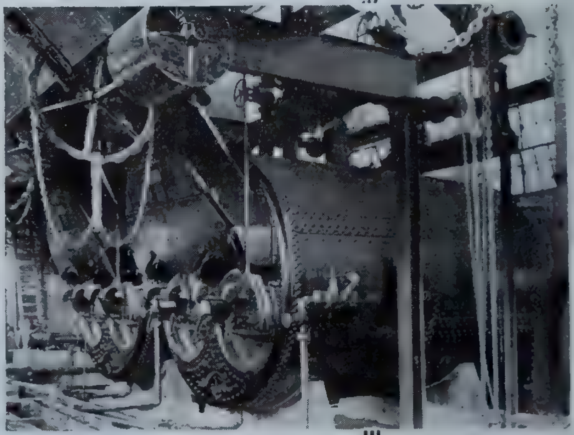

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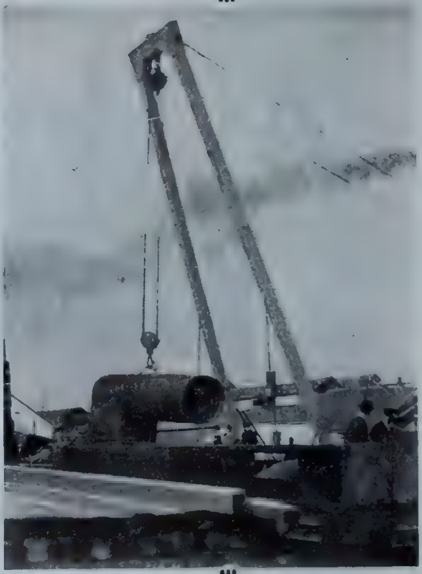

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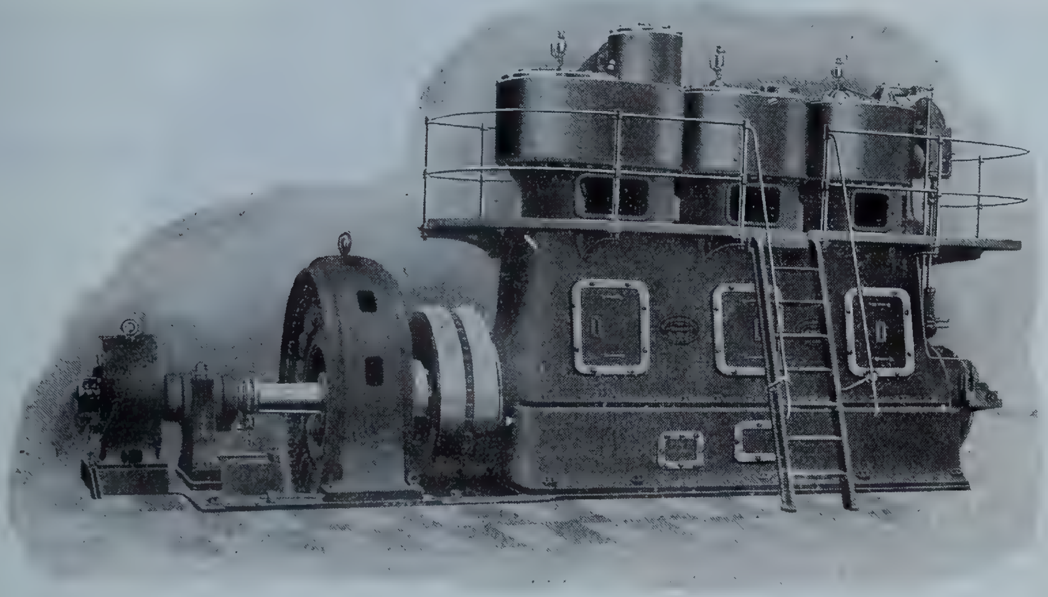

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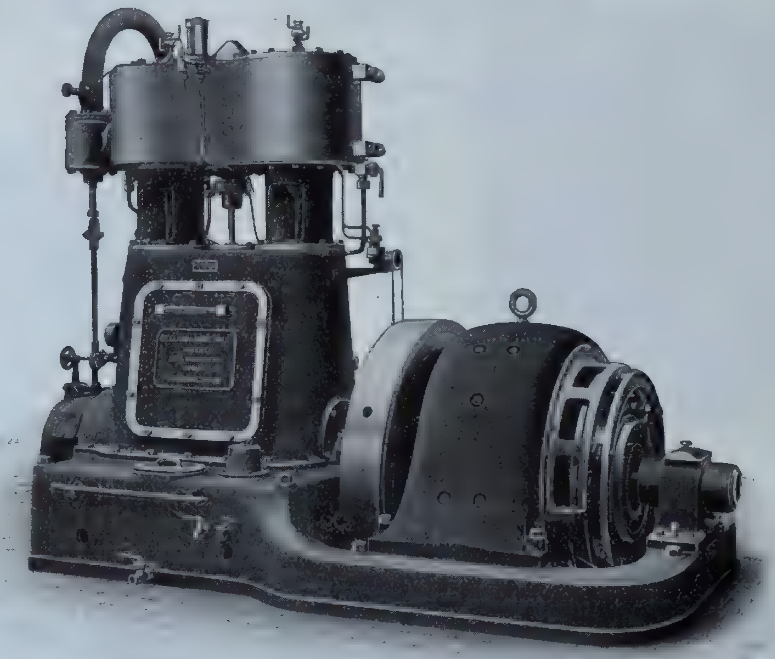

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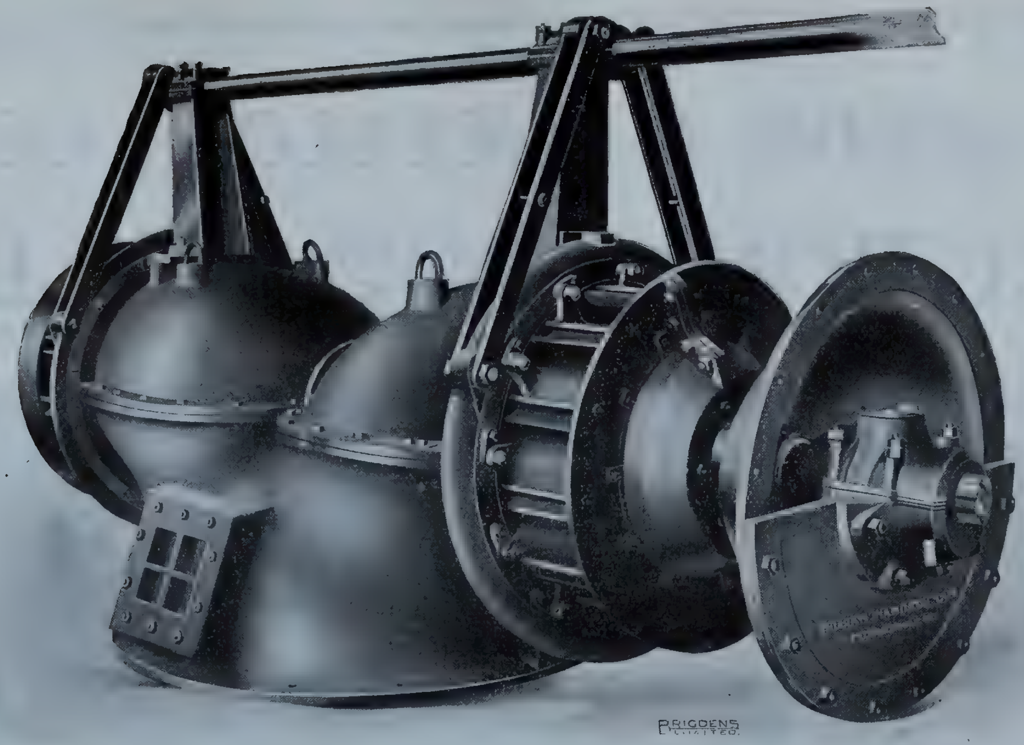

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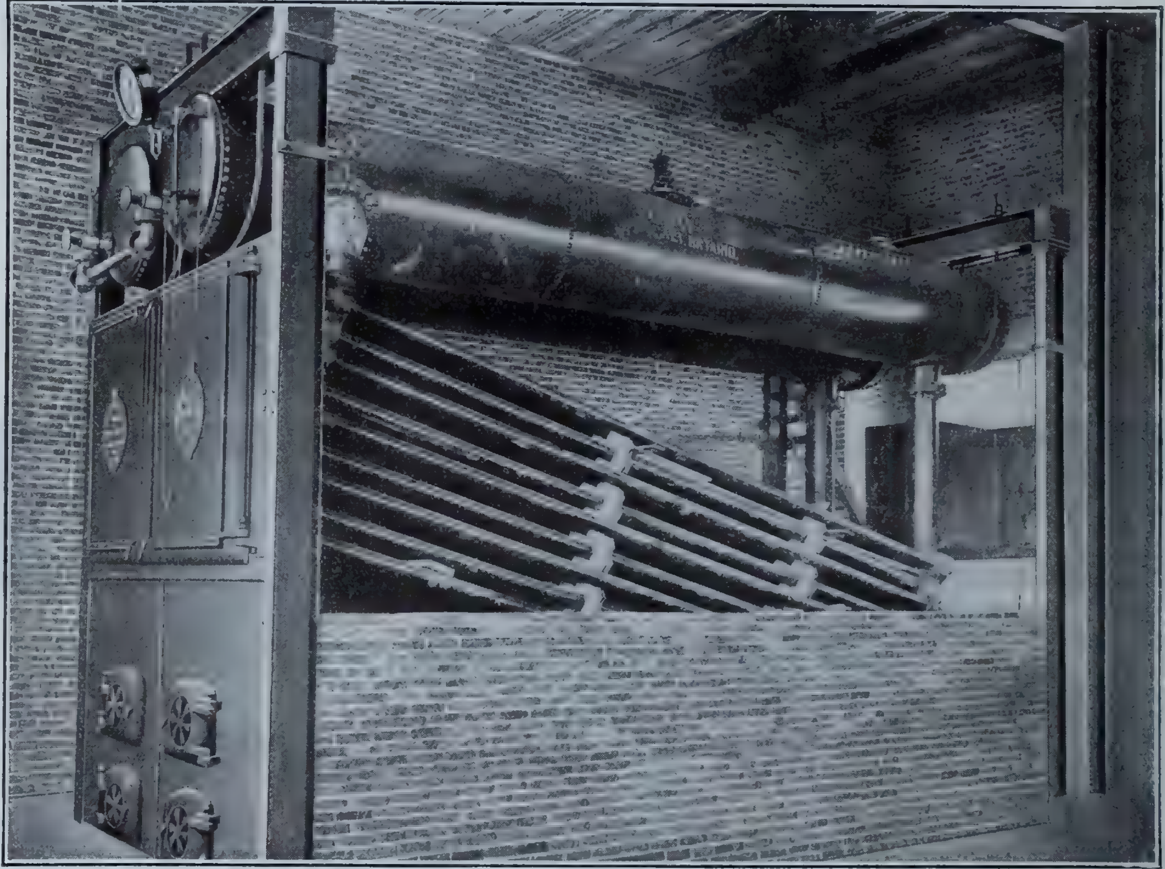

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New Hydro-Electric Plant, the E. B. Eddy Co., Hull, Que.

Staff Article

The installation of modern hydro-electric equipment by the E. B. Eddy Co. places that industrial corporation in the very forefront of Canadian manufacturing enterprise, and serves to show that, notwithstanding the world-wide success attained in marketing their products in days gone by, it became necessary to reorganize their power department so as to take advantage of the progress and development available in that sphere, assuring as it does, more than anything else perhaps, the ability to maintain and even surpass previous achievements.

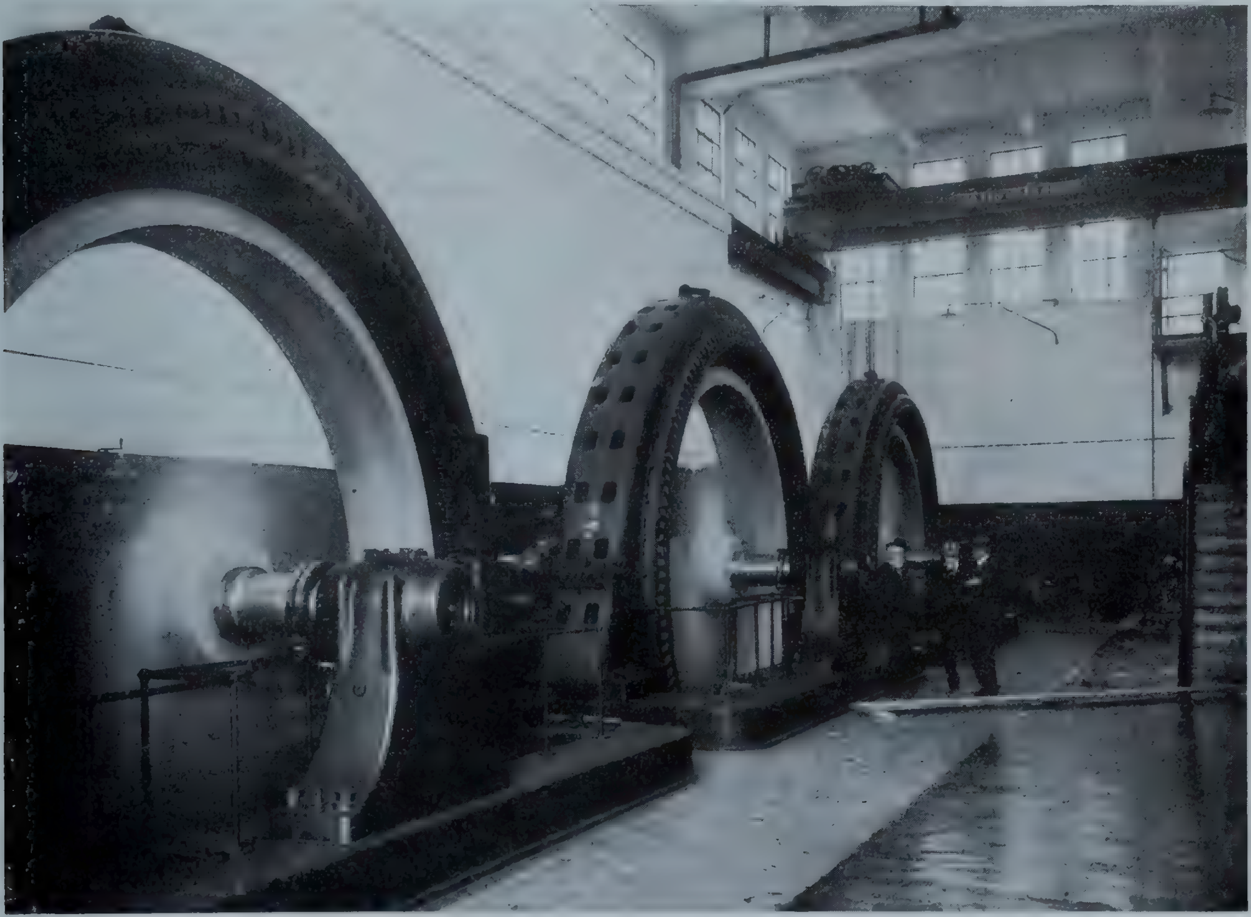
FOR many years the E. B. Eddy Co. have availed themselves of the magnificent water power at their doors, and enjoying a healthy business growth, from time to time have found it necessary to increase their power development. About a year and a half ago their battery of water turbines consisted of thirty-one separate units. These were largely used to supply power to their pulp grinders, and were connected thereto by gears, pulleys, belts, shafting and other mechanical means. Such an extensive amount of gearing demanded a great deal of attention and was no little expense, thus a better and more economical installation was sought. It was also believed that some of the older turbines were not so efficient as the newer types and that a great deal of power was wasted in driving the mechanical devices for transmission purposes. Expert advice was sought, and a new system was devised.

Old Power Plant Discarded Entirely.

In carrying out the recommendations of the consulting engineer, it was found necessary to tear down the old power house and erect a new one to receive the new turbine units and electric generators. The new power house embraced a number of features peculiar to the situation. In the pond above the power house, the water is caused to make nearly a right-angled turn in order that it may be led into the wheels, and to reduce loss by friction and eddying, a series of reinforced concrete curved guides have been placed at the point where the direction of flow of water is changed. These are very ingeniously constructed and serve to bring the water around the bend quite smoothly and with the friction and eddying losses reduced to practically nothing.

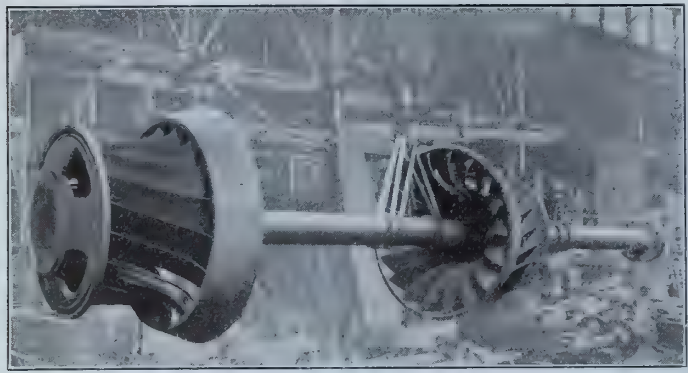
The new power plant scheme involved the installation of fewer but larger turbine units and transmitting the power by electricity to the various machines. To-day the new power house is not only completed but has been giving entire satisfaction for some months. It has proved to be much more economical in the use of water, and the cost of upkeep has, as far as can be determined, been lessened considerably.

Rather peculiar conditions exist at Chaudiere Falls, and to understand thoroughly the Eddy installation these must be explained. A commission of engineers has been given control of the water power at the Chaudiere in order that the water may be conserved and used to the very best advantage. To



THREE 3,750 K.W., 60 CYCLE, 3 PHASE, 2,300 VOLT GENERATORS IN OPERATION.

accomplish this, the commission have realized that the head of water must be maintained so that all water passing through the wheels will be used at the highest limit so far as possible. In those seasons that the supply of water is limited, each consumer is dealt out his proportionate share of the total amount available, the latter being that which may be used without lowering the water above the dam below its high level mark. In this way the water above the dam is always at the high level mark and consumption for power is highly advantageous.



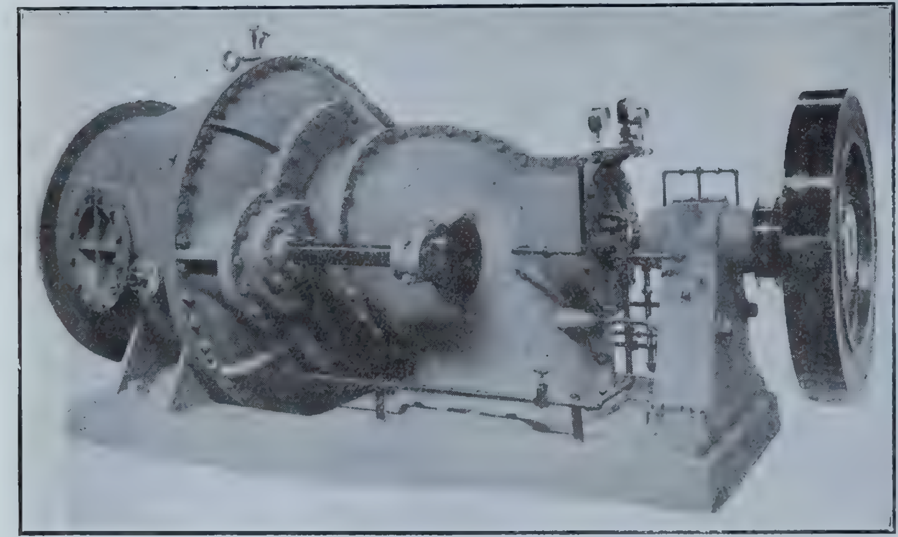
GENERATOR TURBINE RUNNERS.

GENERATOR TURBINE IN SHOP OF BUILDERS.

The Head Feature.

The lowest available head at Chaudiere Falls may be taken as about 26 feet and the highest as about 40 feet, or say 14 feet difference in head between extreme high and low water respectively. The greatest available head (that is, when there is the greatest difference in the level between the surface of the pond above the Chaudiere and the surface of the river below, is at the low water period, or the time when there is the least flow of water in the river. The great difference in the height of fall at The Chaudiere at different seasons is caused by a peculiar situation existing at Grenville, a point about sixty miles below The Chaudiere. Here, the outlet of the river is choked, and at the flood season the flow is retarded and the water banks up all the way along to The Chaudiere. This causes the river rise below the falls, between Ottawa and Grenville, to be much greater than the rise above the falls during the same period.

It was, therefore, necessary to carefully study the water conditions and stages of flow of the river at all times, so as to utilize by means of draught-tubes the full head under the conditions of reduced flow. To so design draught-tubes to take care of the varying head and varying flow of water, and at the same time be able to use the water at all times with the greatest efficiency, was the problem before the engineer. Even at flood time it was demanded that the water be used to good advantage, and it should here be noted that if the turbines were set with the longest draught-tubes possible to take advantage of the 40-foot head existing at low water conditions, with the head reduced to 26 feet at flood time, it is more than probable that the floor of the power house would be below the level of the tail water. The turbines being of the horizontal type and direct connected to the generators, water in the power house would therefore create a general tie-up.



130 HORSE-POWER EXCITER TURBINE UNIT.

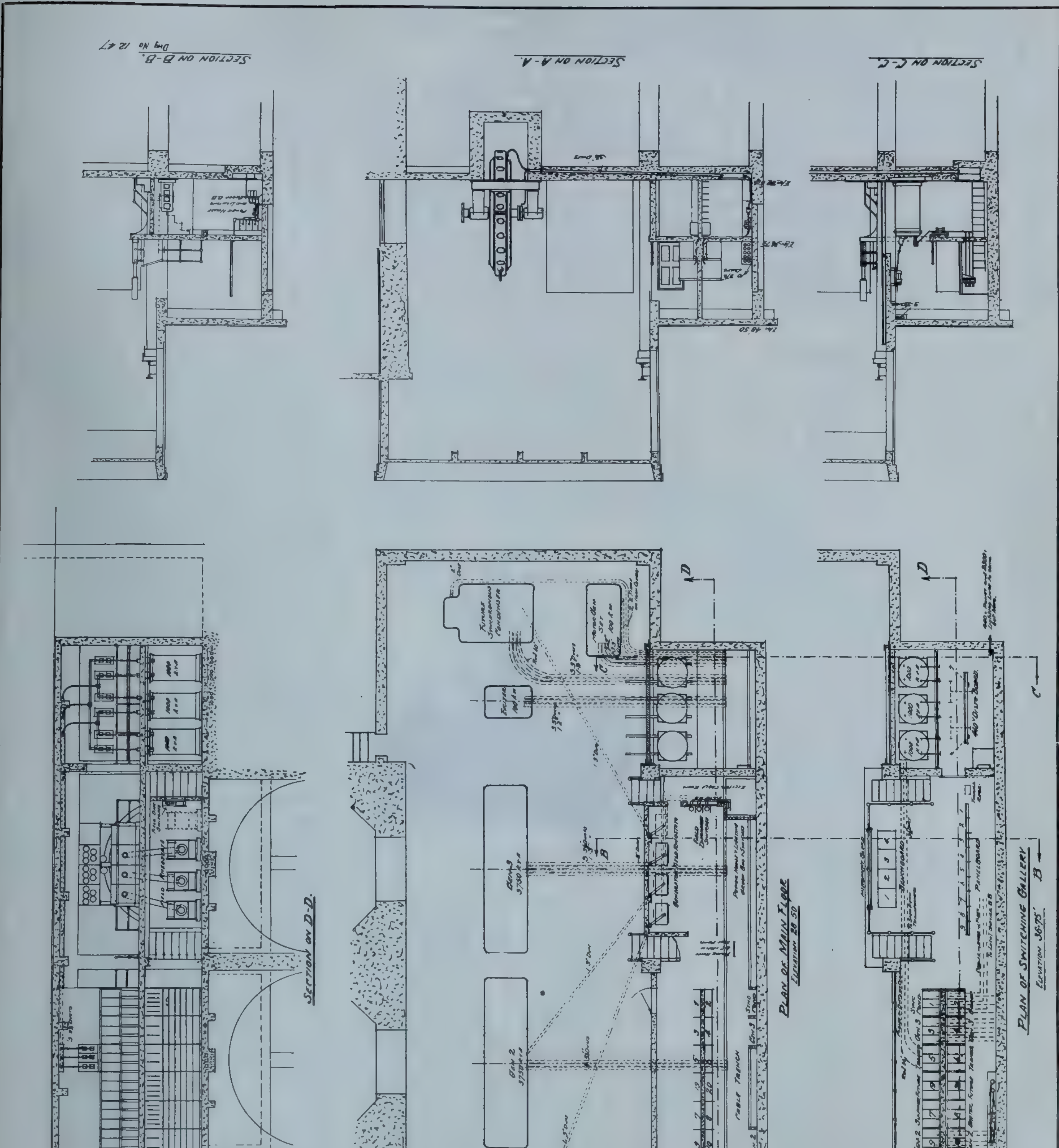
In place of the numerous small turbine units there have been installed three units of vastly increased capacity and of the latest and most efficient design. As before stated, these turbines are of horizontal type design and direct connected to the generators. The latter are equipped with two separate and independent methods of excitation, one of which is water driven and the other is electrically operated. The current generated is utilized to operate the various motors throughout the plant. The larger motor units are situated in a portion of the grinder room in the pulp mill, where they are partitioned off from the grinders so as to be free from the dampness which is always present in a pulp grinding room. These motors are connected to the grinders directly by a shaft extending through the wall dividing the motor room from the grinding room. The whole system is one of extreme simplicity and is the last word in efficient design.

The Forebay.

The water is taken from the Ottawa River just above the Chaudiere dam. It enters the Company's forebay, which is completely covered with a reinforced concrete floor of sufficient strength to carry any future factory extensions which may be deemed necessary to build upon, and then passes on to the turbines. The idea of covering over the forebay was a double one; first, to make the formation of anchor ice an impossibility, and secondly, to provide area for further building extensions. To accomplish the former an exhaust fan has been designed to discharge warm air into the chamber above the water in the forebay in sufficient quantities to prevent the formation of ice in the very coldest of weather. Thus, this trouble has been permanently disposed of.

The Power House.

The power house is located very centrally to the factory buildings. Construction throughout is of reinforced concrete, and the appearance presented



SECTIONAL ELEVATIONS AND PLANS OF THE E. B. EDDY CO. POWER HOUSE LAYOUT.

is a very substantial one. The dimensions of the structure are 114 feet x 38 feet 6 inches. It has been arranged to utilize the full head under all conditions of water levels and quantities of river flow by placing the turbines at elevations above the lowest tail water in the river, at which they can be made fully efficient by long, properly shaped draught tubes, and then so building the power house as to provide against the flooding of the dynamo room in high water periods. This has been successfully accomplished in this instance as well as in another power plant on the Ottawa River.

Disposition of the Equipment.

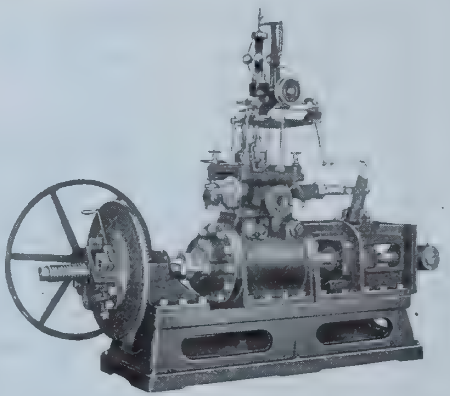
The three large generators, turbine governors and exciters are under the eye of the operators and are so designed and installed as to be convenient of access for repairs. To further the accessibility of the turbines, etc., a 50-ton electrically operated crane travels over the entire floor area. Each unit of the three turbines is placed in a penstock 24 feet wide x 55 feet long, with steel reinforced concrete walls built on a concrete foundation and floors. The entrance to each penstock is controlled by gates of steel construction known as the Stoney sluice type. The dimensions of these gates are 26 feet x 21 feet, and operation is by the travelling electric crane mentioned previously. In the construction of the power house the crane was set in position before the wheels were set and used to place the turbines in position.

In the last quarter of a century there has been a complete revolution in the manufacture of water turbines. Several conditions have brought this about, but the principal factor was the wonderful development of electricity with its amazing features of adaptability and flexibility. Since its advent into the sphere or power transmission, water power has been made to play a far more important part in the commercial life and development of the country. The general practice formerly was to manufacture turbines from stock patterns and harness these wheels up to waterfalls in many and various ways, generally with little or no regard to final efficiency.

The situation has now assumed an entirely different complexion. The various water powers have been studied and turbines have been designed to meet the special conditions presented in each case. Engineering skill has been applied to conduct exhaustive tests and experiments until the science has been mastered to a great degree of perfection. The draught tube has been understood and successfully applied, efficiency under high and low heads has been attained, and the various merits of horizontal and vertical units under varying conditions have been learned.

Turbine Features.

The thirty-one units formerly installed at the Eddy Works have now been replaced by three large units. The average head of water is 32 feet and, under this head, each of the three turbines now installed, develops 4,500 h.p. and make 146 revs. per min. Each unit consists of four runners which discharge through two draught-tubes. The guide vanes are made of cast steel and the buckets are made from ⅜-in. steel plates, welded into the cast iron rims by a special process. The hubs of the turbines are forged integral with the turbine shaft, as also are the flanges which do duty as couplings at each end of the shaft. Each turbine shaft is 45 feet long, in which length there are four couplings. The guide vanes of the turbines are all accurately adjusted so that the gate openings to each of the four runners composing a unit are always uniform.



60,000 FT. POUNDS HORZ. TYPE LOMBARD GOVERNOR.

A feature of the installation is the arrangement of the runners on the shaft so that the end thrust on each unit is balanced. Thus, small thrust bearings only are fitted to the shafts to take care of any small item of thrust which may at times occur. These small bearings are sufficient to keep the units exactly in their place. In addition to these three power units there is a fourth smaller unit which generates electricity of the d.c. variety used in the excitation of the big generators. This turbine is of the horizontal type also, and under a head of 30 feet developes 130 h.p., making 425 r.p.m. The large generators can either be excited by this separate unit or by an entirely different electrically operated unit.

The Governor Mechanism.

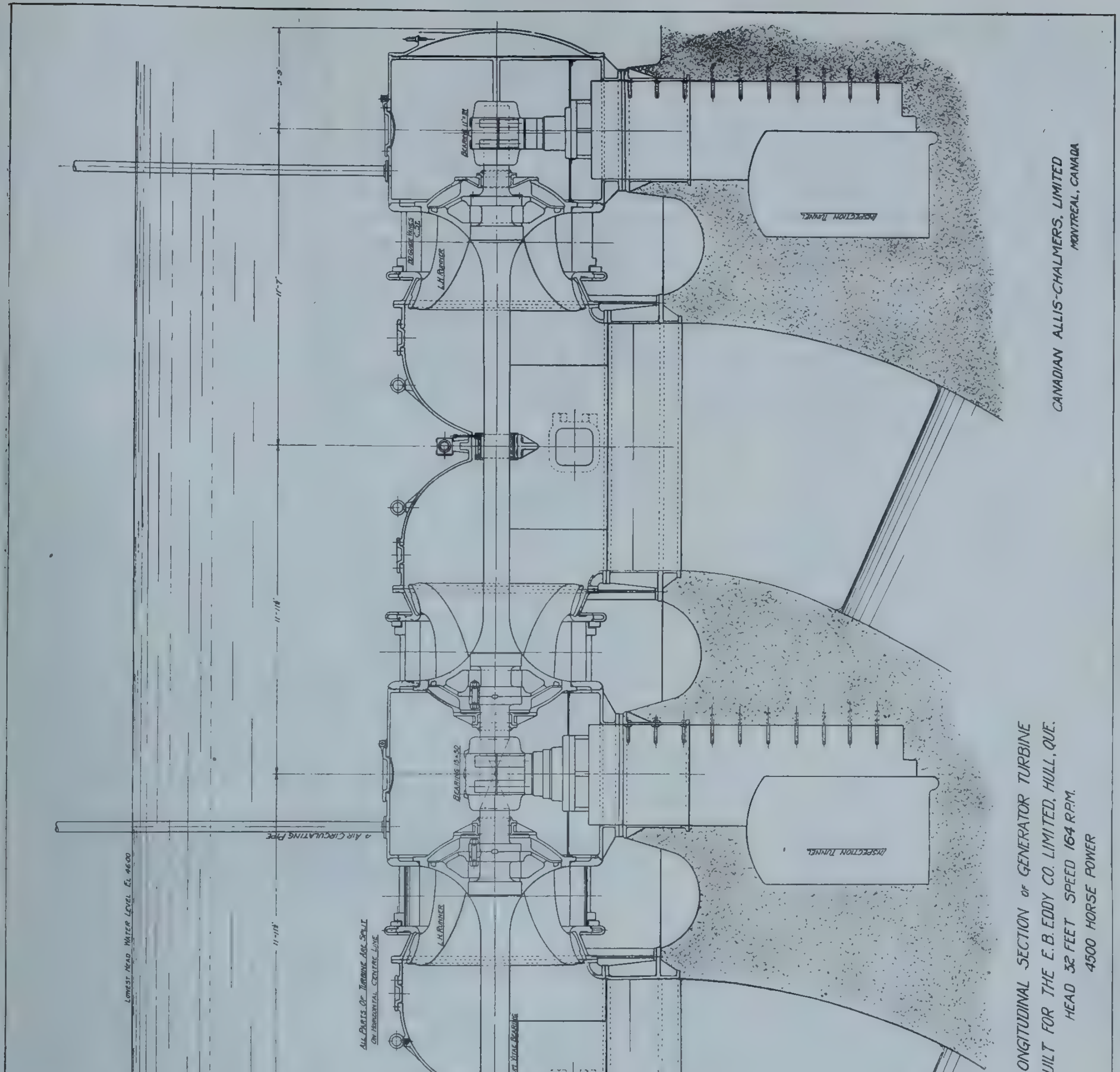
The three water wheel governors were manufactured by the Lombard Governor Co., Ashland, Mass., and in their design a number of interesting features are to be noted. The relay valve mechanism is under fluid control and has no positive connection with any of the mechanically moving parts of the governor. This relay valve is operated by the position of the primary valve, which is directly under control of the centrifugal ball mechanism, and the design is such that the relay valve takes its full travel instantly, no matter how small an amount the primary valve moves; hence, there is no wire-drawing effect on the servemotor valve or power cylinder part of the governor.

Governor Control.

The design is such that the lap of both the primary valve and the relay valve may be changed while the governor and water wheel are in normal operation. As the lap of the primary valve controls the sensitiveness of the governor, and the lap of the relay valve controls its time operation, it is manifest that any adjustment for sensitiveness of operation can be made while the governor is in commercial service. The hand control mechanism is powerful and consists of a split nut working on a screw-threaded projection of the main piston rod. The split nut may be opened or closed by the lever shown. When closed, the wheels are under hand control; and when open, they are under governor control. The thrust of the hand-wheel mechanism is taken up on roller bearings; thus permitting the hand wheel to work at a very high efficiency. One man can easily, with one hand, move the hand wheel at any position of water wheel gates. The paralleling effect of these governors is adjustable, so that they may be given any degree of isochronism desired.

They develop 60,000 ft. lbs. each at 200 lbs. tank pressure in the act of moving the water wheel gates through their entire range, but are, however, operated at 150 lbs., and develop 45,000 ft. lbs., which is found ample for the above purpose. They may be adjusted to give a complete range of gate motion in one second, or any slower time desired. The pump and tank equipment, not shown in the cut, is of the standard design of the Lombard Governor Co.; the pump being their standard 100-gallon vertical triplex, immersed plunger type; the pressure tank being of electrically welded steel, having a capacity of 446 gallons. The receiving tank is of similar construction, and having a capacity of 246 gallons.

The method by which these governors are connected to the gate equipment of the water wheels is by lever on the gate shaft mechanism connected directly to the double forked connection on the governor piston rod, shown to the extreme right of the cut.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BUILT FOR THE E.B.EDDY CO. LIMITED, HULL, QUE.
HEAD 32 FEET SPEED 164 R.P.M.
4500 HORSE POWER
INSPECTION TUNNEL
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ALL PARTS OF TURBINE ARE SPLIT ON HORIZONTAL CENTRE LINE
L.H. RUNNER
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CROSS CONNECTION FOR RIG SHAFTS
THRUST BEARING
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SPLIT RIG RINGS ON ROLLERS
EL. 27.00

LONGITUDINAL SECTION THROUGH ONE OF THE FOUR RUNNER GENERATOR TURBINES, E. B. EDDY CO. POWER PLANT.

The Generators.

The three generators installed are for direct connection to horizontal shaft water wheels, and each has a normal load capacity of 3,750 kilo-watts. They are of the 60 cycle, 3-phase, 2300 volt type. They are direct-connected to the turbines and thus operate at a speed of 164 r.p.m. The application of the power is through the medium of induction motors located in the grinding room and in various other places through the factory. The larger motor units are used to drive the grinders and these units are direct connected to their load. Whereever possible, the principle of direct connecting prime movers to their load has been applied. The stator coils of the generators are insulated from the laminations with mica tubes and the rotors, which are banded with steel rings, are constructed to withstand a 100 per cent. overload in a mechanical as well as an electrical sense, which overload might easily occur in the case of a runaway.

The guaranteed efficiency of the generators by their manufacturers, the Swedish General Electric Co., is of particular interest and is as follows:

One and one-quarter load, 96 per cent.
Full load, 96 per cent.
Three-quarter load, 95 per cent.
One-half load, 93 per cent.

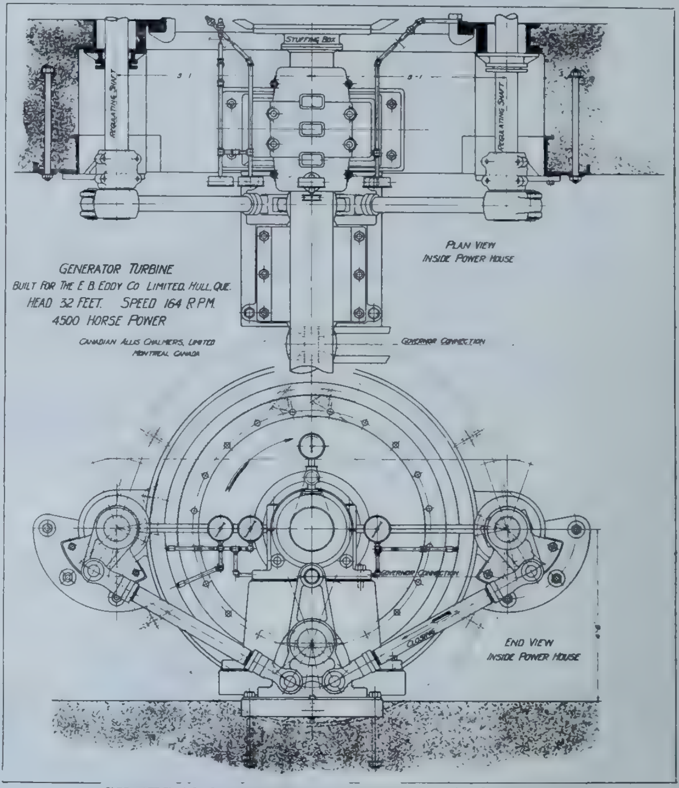
The machines were all able to increase these efficiences slightly in tests carried out in the workshops of the manufacturers by a disinterested firm of consulting engineers. The regulation test of these generators also proved far in advance of expectations.

The exciter unit consists of a 100 kilo-watt, compound wound, interpole, d.c. generator, direct connected to its turbine, which operates at a speed of 450 r.p.m. There is also installed a 100 k.w. motor generator set running at 580 r.p.m, with an electrically operated equalizer switch. This set is to be used for exciting the main generators in case of a break-down in the hydraulically operated exciting unit.

Switchboards and Controls.

The switchboards are placed in a gallery built over the bus chamber, step-down transformers and oil switches, which are electrically operated. The bus chamber contains two sets of bus bars, on to which any of the machines or feeders can be sectionalized. Further, the two sets of bus bars can be run in parallel, if so desired. The whole structure is of concrete.

The control of the generators is from a bench board, by electrically operated field switches and electric governor. The instrument board for the machines is mounted on pedestals immediately behind the bench board. Each generator panel has three ammeters (one for each phase), a volt meter, power factor meter, and watt meter. There is also a frequency meter, and a volt meter on each set of bus bars. The distributing panel for the 2300 volt circuits is located on the far side of the bench board, as are also the exciter panels and the Terrill regulator.

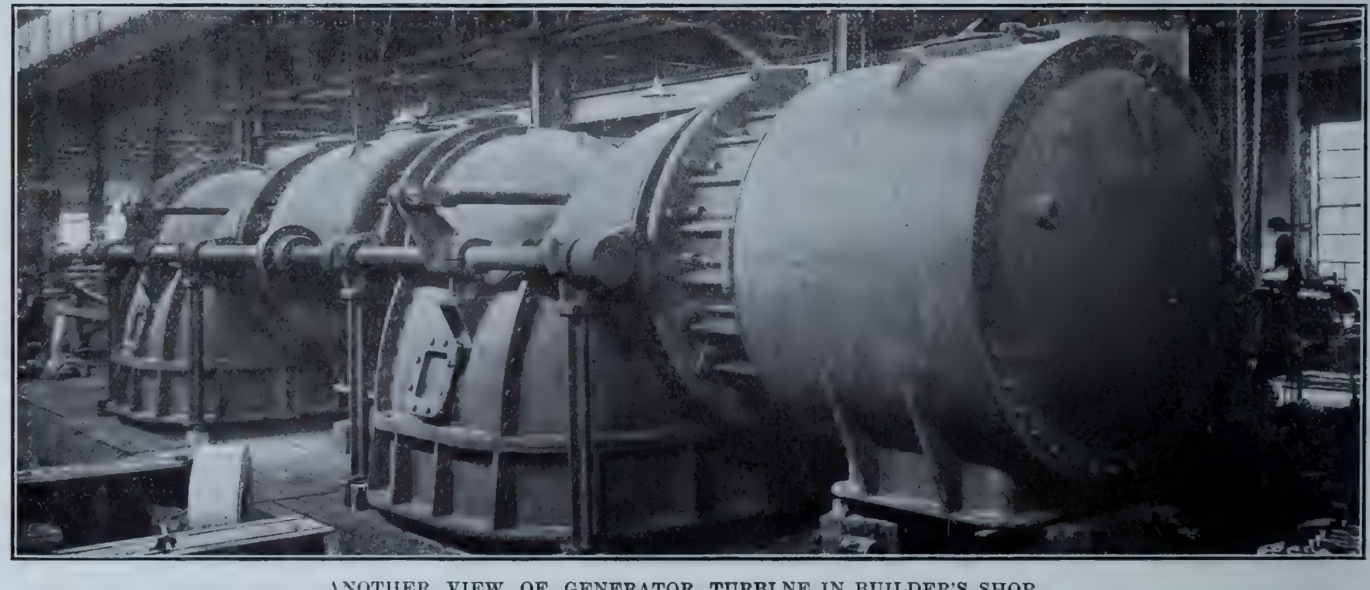


GENERATOR TURBINE SHOWING CONTROL.

The transformer units consist of three single phase, 2300/400 volt transformers of 1,000 kilo-watt capacity, oil insulated, water cooled, and step-down for the paper mill service.

Motor Room and Pulp Mill.

In this department we find by far the



ANOTHER VIEW OF GENERATOR TURBINE IN BUILDER'S SHOP.

most efficient and gratifying results of the new installation. The system, briefly described, is that of large capacity turbines direct-connected to generators transmitting power by electricity to motors direct-connected to their load. The arrangement, besides being efficient, is also very flexible, and has come up to all expectations.

In the motor room are installed the large motor units. They are here protected from the dampness of the grinding room. Four motors are now installed and provision is made for the fifth when the increase in demand for power is in excess of that which the four at present installed, can supply. All the motors here are direct connected to their loads,the shafts extending through the wall to the grinder room beyond.

The mill is 180 feet by 134 feet and is divided into three longitudinal sections about 40 feet wide. The construction is of steel and concrete throughout. The mill motor room is designed for five main units, the four at present installed being of 1200 h.p. induction type, H.F., 2200 volt, 233 r.p.m. The motor shaft extension in each case passes through the wall into the grinder room where it is direct connected to three 3-pocket New England grinders with stones 26 inches wide by 54 inches long. One of the grinders is however equipped with stones 34 inches wide to take care of any piece of wood which is too long for the 26-inch stones. The controls of the motors are all located conveniently near their respective machines. An ammeter forms part of the equipment of each machine so that the operator knows at all times the load he is putting on.

Provision is also made for two refiners consisting of three stones on one shaft direct-connected to one 220 h.p. type H.F. 2200 volt, 290 r.p.m. machine The motor is placed in the motor room while the refiner is situated in the grinder room. The same method of direct connection, as employed in the case of the grinders, is also used here. Only one set is at present installed. The transformer equipment is also located in the motor room. The distance between the power house and the motor room in the pulp mill is about 800 feet.

The Manufacturing Achievement.

The course of a stick of wood as it goes through the mill is rather interesting. From the time it is barked and placed in the grinders it does not touch a human hand till it becomes the finished product—paper in the paper mill. The wood goes first to the butting mill where it is sawn into 24-inch lengths. It is then conveyed to the room where are installed the Waterous barkers. After being barked, the wood is dropped into a water tank and from there it floats in concrete troughs to the grinders. After being ground into pulp it is pumped into the centrifugal screens where the slivers are extracted. The good pulp then runs by gravity to the slush vats, where the excess water is removed. The "white water," as the excess is termed, is used again on the screens and grinders. From the slush vats, the pulp goes to the storage tank, which has a capacity of 75 tons dry weight. Centrifugal pumps take the pulp from the storage tank and force it through two 10-inch pipes to the beaters. The slivers that are removed from the pulp are returned to the grinders and re-ground. Thus all the material is saved. The "white water" is filtered through three save-alls and the good pulp sent to the storage tank.

The present capacity of the mill is about 85 tons of high-grade pulp per day of twenty-four hours, with the four grinders. With the fifth grinder installed, the capacity will be increased to 105 tons per day. These figures are for really high-grade pulp, but if a lower grade were manufactured, the capacity could be correspondingly increased.

Motor Particulars.

The small motor units are all wound for 440 volts, three phase, and are fed from the main 440 volt switchboard in the motor room. All the wiring is enclosed in conduits. The following is a list of the motors installed:

H.P.	SYN. SPEED	TYPE	CONNECTED LOAD.
1200	240	H. F.	Direct connected to three 3-pocket New England grinders.
200	300	H. F.	Direct connected to refiner with 3 stones on one shaft.
100	514	S. Cage	Direct connected to countershaft for 8 wet machines.
85	1800	S. Cage	Direct connected to centrifugal pump for grinders.
75	514	S. Cage	Direct connected to countershaft for three centrifugal screens. (Mill designed for 5 screens.)
60	720	S. Cage	Direct connected to centrifugal pump for pumping pulp from storage tank to heaters—800 feet.
40	1200	S. Cage	Direct connected to centrifugal pump for pumping pulp from storage tank to heaters—800 feet.
55	720	S. Cage	Direct connected to countershaft for 3 barkers.
50	1200	S. Cage	Direct connected to centrifugal pump for pumping water to wet machines.
40	1200	S. Cage	Belted to 14 slush vats.
30	720	S. Cage	Direct connected to centrifugal pump for pumping white water to screens and grinders.
30	600	S. Cage	Direct connected to centrifugal pump for pumping pulp from save-alls to storage tank.
25	900	S. Cage	Direct connected to fan for blowing shavings from barkers to boiler house.
20	514	S. Cage	Direct connected to centrifugal pump for pumping circulating water in the wood troughs.
15	720	S. Cage	Direct connected to countershaft driving three save-alls.

The turbines were supplied by the Canadian Allis-Chalmers Co., Montreal; the governor by the Lombard Governor Co. of Ashland, Mass.; the generators by the Swedish General Electric Co., through their Canadian representatives, Kilmer, Pullen & Burnham, of Toronto. The motors and the electrical apparatus in the power house and motor room were all supplied by the Canadian Westinghouse Co. and the Canadian General Electric Co.

The design and construction of the entire plant, including the hydraulic development, electric equipment and also the building of the pulp mill, were entrusted to Wm. Kennedy, Jr., Consulting Engineer, Montreal, and Mr. Kennedy secured the services of Dr. L. A. Herdt, electrical engineer, Montreal, to take full charge of the details of the electrical equipment.

Summary.

This plant is now among the most modern of Canadian industrial institutions, and such plants are always a source of much pride, particularly to the engineering community. The E. B. Eddy plant is one of which they can be justly proud, and the economical operation of such a plant can hardly be questioned. The extra investment is an excellent insurance against interruption from breakdowns or other failures due to more or less unreliable equipment.

* * *

Brunler System of Boiler Firing.—An ingenious German invention, of which our engineers may possibly take advantage, is the Brunler system of steam boiler firing. The novelty of this system is the use of a high-pressure gas or oil jet submerged in the water of the boiler. Descriptions of the invention which have appeared in the German technical papers state that hitherto, and by all present methods, the heat of the fuel is transmitted to the water through the walls of the boiler. This involves considerable losses of heat and material. According to a contemporary, the Brunler method of submerged firing, which eliminates these losses, has been used with great success in a German chemical factory. The boiler plant consists of a cast steel generator in which the flame burns under the surface of the liquid, and of a cast iron collector for the liquid, the steam and the gaseous products of combustion. The fuel used is coal tar oil.

* * *

Montreal, Que.—City Engineer Janin has recommended that a 24-million gallon pump be installed at the low-level pumping station instead of two 12-million gallon pumps, for which tenders were received two months ago. The Board of Control will consult the city attorneys regarding the cancellation of the former tenders.

Valve Mechanism, The Weir Reciprocating Steam Pump

Staff Article

With the continual advance to higher degree perfection of power generating machinery, it became incumbent on those who specialized in the manufacture of auxiliary and accessory equipment to at least keep pace, and in no department of the latter (due largely to their increased applications), has more substantial progress in the dual direction of efficiency and reliability been made than in that of the design of reciprocating steam pumps.

THE design of reciprocating pumps driven by steam has always presented difficulties not usually encountered in other forms of reciprocating engines. In the early days of pumps, weight of machine and efficiency of operation did not enter as vitally into the calculations as they do to-day, it being often sufficient that the pump would work and be nominally reliable. However, duties of pumps have become more severe and users have demanded higher efficiencies.

Water being practically an incompressible fluid, presents certain problems which make the expansive use of steam rather hard to realize in pumping cylinders, and since designers have for the most part done away with flywheels, the problem of actuating the valve and at the same time eliminating the possibility of the machine becoming centred, has assumed new proportions. Nearly every other type of engine in use depends upon motion obtained from a revolving shaft to actuate its valve link motion, but the small and medium sized pumps of to-day have no circular motion imparted to their moving parts, thus this method of operating the valves must be left out of all consideration of the subject.

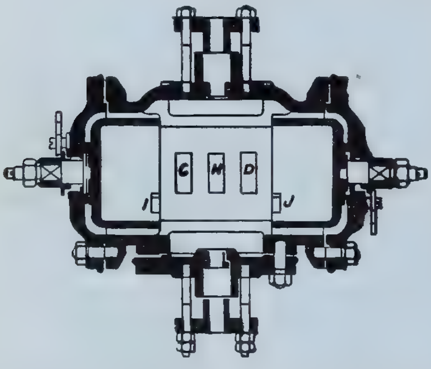


FIG. 1. VERTICAL SECTION OF STEAM CHEST THROUGH CENTRE LINE OF AUXILIARY VALVE STEM. VALVES REMOVED SHOWING MAIN VALVE SEAT.

Pump Design Development.

There have been many very succesful designs of pumps developed and several principles have come to be recognized as standard. The duplex pump is about the commonest type encountered, being most generally used in small units for boiler feed and service purposes. It is not an expensive type of pump although some firms manufacturing it have enlarged on the original idea of a duplex and have made them with compound steam cylinders, and outside packed, double acting, water cylinders. The fact that the pump is duplex makes the valve operating problems somewhat more simple. The single cylinder type of pump presents more serious problems. In its class, however, there are many very efficient designs, and perhaps the most widely known of this type is the Weir Pump of British manufacture.

G. & J. Weir have been identified with the pump business for many years and at Cathcart, Glasgow, Scotland, have one of the best equipped factories in Great Britain. Its best efforts are devoted to the manufacture of steam driven pumps. The same underlying principles of design have been applied to small medium and large sized units.

The Weir pump has been utilized largely in all places where such an auxiliary is required, its most important uses being for marine, stationary, and locomotive boiler feeds. The pump also finds favor as a service unit where its duties are particularly severe.

Air pumps to be used in connection with condensing installations, are also made, the general design being that of the single cylinder vertical type, although the horizontal type is used in a number and variety of instances. The outstanding features of the pump are its reliability and efficiency. It is particularly suited for marine auxiliary work as is evidenced by the fact that it is in general use in twenty-four navies including the British, French, Russian and German, around which so much interest is centred at the present time. The chief merchant marine vessels are also large users. This reception, in circles whose demands are so difficult to fulfil, is in itself a striking testimony to the merits of the Weir product.

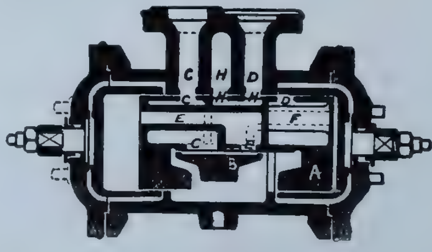


FIG. 2. HORIZONTAL SECTION THROUGH STEAM CHEST SHOWING VALVES.

The Valve Feature.

The one outstanding feature of Weir pumps is the steam valve, and after all, the valve is really the brain, as it were, of any steam engine. In what follows, an attempt will be made to describe the valve of a single cylinder vertical pump throughout its whole cycle of operation.

The steam valve consists of two moving parts, each separate valves in themselves, and known as the main and the auxiliary valves. The function of the main valve is to distribute steam to the cylinder. The main valve is half round in its central cross-section, but at each end the casting is extended and this extension has a circular cross section. The main valve seat is bored out to fit the valve. The motion of the main valve is entirely horizontal, and on the back of its central, semi-circular section, is a flat machined surface which is the seat of the auxiliary valve. The motion of the auxiliary valve is entirely vertical and this motion is received through a link motion from the piston rod.

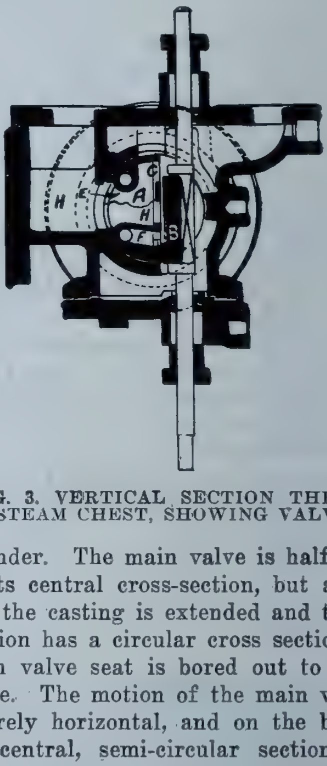


FIG. 3. VERTICAL SECTION THROUGH STEAM CHEST, SHOWING VALVES.

The function of the auxiliary valve is a double one. It has to distribute steam to either end of the main valve in such a manner as to cause it to move from end to end of the steam chest so as to accomplish its duty of delivering steam to the cylinder. The second duty of the auxiliary valve is to cut off the steam from admission to the cylinder at the proper time in the cycle of operation. These valves have been so ingeniously designed that full and complete strokes are made at all speeds of operation. Both valves are of the slide type, and the main valve cannot rest except at the end of its stroke.

The main valve has only the one simple horizontal movement, while the auxiliary valve has the simple vertical motion, but as its valve seat, the main valve, moves, the auxiliary valve has here a relative motion in addition to its real motion, and this relative motion must be closely studied. The arrangement of this double valve is such that it is impossible for a dead centre to occur.

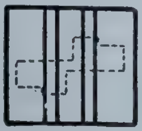


FIG. 4. AUXILIARY VALVE.

The cylindrical ends of the main valve are turned round, while the ends are left flat. Over these round ends are placed caps forming closed cylinders in which the flat round ends of the main valve act as pistons and so contribute to the horizontal motion of the main valve. Through ports on the back of the main valve, the auxiliary valve admits steam to these cylindrical chambers, and this steam being thus distributed to the ends of the main valve gives to the latter its motion.

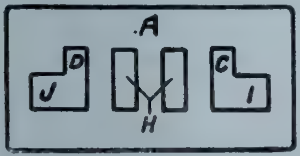


FIG. 5. SEMI-CIRCULAR FACE OF MAIN VALVE.

The auxiliary valve accomplishes the cut-off at about three-quarters of the piston stroke; thus the last quarter of the stroke is the result of expansion. This transmits to the pump a very smooth and regular motion, allows all water valves to settle quietly, and relieves all water connections from undue shock.

Cycle of Operation.

In following the valve through a complete cycle, it will be necessary to refer constantly to the figures 1 to 6 inclusive. The letters of reference will be found the same in all of the six figures. Starting with the piston at the bottom of its stroke, the main valve A is at the right hand end of the steam chest, as shown in Fig. 2. It is in this position because the port E (Fig. 2 and Fig. 6) is open to live steam. This port leads to the left chamber at the end of the main valve and thus holds the valve to the right. The auxiliary valve B is at the bottom position in its travel and, as the main valve A is to the right position of its travel, the auxiliary valve B is at the lower left corner of its valve seat on the back of the main valve A. In this position the top edge of the auxiliary valve B is just flush with the bottom edge of the port C (Fig. 6). Thus the port C is open to the live steam. Now the port C leads to the bottom of the cylinder below the piston, and thus the piston starts to move upward.

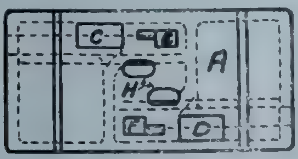


FIG. 6. BACK OF MAIN VALVE SHOWING AUXILIARY VALVE SEAT.

Key to Fig. 7.

1.—Steam slide valve chest.
2.—Double joint.
3.—Front stay.
4.—Bottom spindle.
5.—Valve gear levers.
6.—Front stay bush pin.
7.—Ball crosshead.
8.—Main crosshead.
9.—Crosshead pin.
10.—Piston rod.
11.—Piston body.
12.—Piston rings.
13.—Cylinder cover.
14.—Discharge valve seat.
15.—Discharge valve seat ring.
16.—Suction valve seat.
17.—Suction valve guard.
18.—Discharge valve guard.
19.—Water valves.
20.—Bucket.
21.—Pump rod.
22.—Pump cover.
23.—Valve Chest covers.
24.—Steam stop valve.
25.—Exhaust stop valve.
26.—Auxiliary valve spindle.

Cycle of Operation (Cont'd).

By referring to Fig. 7, the link motion which actuates the auxiliary valve A can be seen. Through the crosshead pin 9 the gear lever 5 is caused to move about the fixed stay bush pin 6 by the motion of the rod 10. The little ball crosshead 7 moves up and down on the valve stem bottom spindle 4, and as soon as this little crosshead comes up against the adjustable nut collars on the bottom spindle, it moves the latter, and thus the valve B receives its motion. The adjustable nut collars are so set that the valve stem spindle starts to move at just half stroke of the piston.

To return again to the valve chamber, we have left the ports E and C (Fig. 6) open to live steam. The piston has started to move upward. As soon as the piston reaches its half stroke, the piston rod starts to move the auxiliary valve B and, immediately the auxiliary valve B starts to move upward, it starts to cover the port C (Fig. 6). At three-quarters piston stroke, the port C is fully covered and cut-off is accomplished. The remaining quarter stroke is completed by the expansion of the steam. As the piston reaches the top of its stroke, the auxiliary valve B moves over the port E (Fig. 6) and thus cuts off the chamber to the left of the main valve from its connection with the live steam.

By referring to Fig. 4, it will be noted that the shape of the hollow on the face of the auxiliary valve is shown by dotted lines. This hollow portion, as the travel of the auxiliary valve B continues upward, registers over the port E (Fig. 6) and the upper port H (Fig. 6) also registers against the hollow on the face of the auxiliary valve B. As the port H (Fig. 6) connects with the main exhaust port, the steam from the left hand end chamber of the main valve A is open to exhaust and, as the auxiliary valve B is opening the port E to exhaust, it also is opening to live steam the port F (Fig. 6).

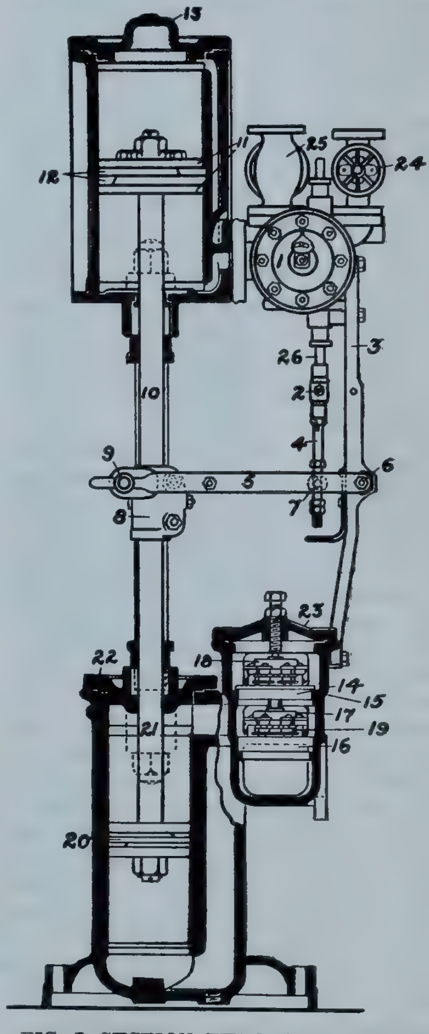


FIG. 7. SECTION THROUGH "WEIR" FEED PUMP.

Now the port F leads to the right end chamber of the main valve A, and as soon as the port F is opened to live steam and the port E opened to exhaust, the steam pressure against the right hand end of the main valve causes the valve to move to the left end of the steam chest. However, as the main valve A moves to the left it cuts off the port E from exhaust at about the time that the main valve has accomplished about three-quarters of its travel. The steam trapped in chamber to the left of the main valve thus cushions the valve and causes it to stop without any jar as soon as the pressures on either end of the valve are equalized. The valve motion is so timed that the main valve A has just reached the end of its travel as the piston has reached the top end of its stroke.

All along, the port D (Fig. 6) has been opened to live steam, but until the main valve A moved over to the left end of the steam chest, the port D did not register against the cylinder port D (Fig. 1), and thus the steam was not admitted to the cylinder above the piston until the main valve A had moved to the left. Now, as the steam pressure from the steam chest is acting on the top of the piston, the motion of the piston is reversed, and the piston starts on its downward stroke. When the main valve A moved to the left, it also brought the cylinder port C (Figs. 1 and 2) to register against the exhaust port H on the back of the main valve A (Figs. 2 and 5), and this port H in turn registers against the cylinder exhaust port H and makes the exhaust circuit complete. As the piston continues on its downward stroke, the steam below the piston is free to pass out.

The auxiliary valve B is now in the right upper corner of its valve seat, and the lower edge of the auxiliary valve is just flush with the upper edge of the port D (Fig. 6). When the piston has completed the half of its stroke, the valve stem picks up its motion from the piston rod, and the auxiliary valve B starts to move down over the port D and when the piston has accomplished three-quarters of its stroke, the valve B has covered the port D completely and the cut-off is accomplished. The rest of the stroke is completed by the expansion of the steam, the auxiliary valve B continuing on its downward stroke. It opens the port E (Fig. 6) to live steam, and this ports leads to the left end chamber of the main valve A. Also the port F is opened to exhaust, and as this port connects with the main valve right end chamber, the latter is opened to exhaust.

With these conditions existing, the main valve A moves over to the right end of the steam chest, and we then find conditions existing just as are shown in Fig. 2. The trapped steam at the right hand end chamber of the main valve stops the main valve as previously explained in connection with the similar event at the other end of the main valve A. The cylinder port D is next opened to exhaust through the exhaust port H at the back of the main valve A, and the port C is opened to live steam which is led to the cylinder under the piston; the cycle being about to commence again.

It has been shown that the steam to drive the pump is cut-off before the end of the stroke is reached, but the pump would not complete its stroke under certain conditions by the expansion of the steam in the cylinder. For instance, when starting and with a cold cylinder, the steam already shut in the cylinder would rapidly condense and fall below the pressure necessary to move the piston. It is, therefore, necessary to admit steam after the auxiliary valve has closed it from entering the cylinder through the main ports C or D on the face of the main valve. This is done by arranging a bye-pass for each end of the cylinder. This bye-pass can be opened by hand, and allows steam to pass into the cylinder after the auxiliary valve has closed the main port C or D leading to the bottom or top of the cylinder. These bye-passes I and J are arranged by cutting a port in the caps or small cylinders on each end and at the back of the main valve, on which a corresponding port is cut. Provision is made on each end of the steam chest to turn these cylinders on the valve and so open or close the port. By this method live steam is admitted to the cylinder as long as the ports E and F are open to live steam which is the whole length of the stroke.

The pumps are made with double acting pump cylinders.

The Method and Manner of Laying-out Plates

By Joseph W. Ross

The laying-out of plates to form the various shapes for which sheet metal parts are used involves difficulties that are only discovered when such a job is undertaken. It is well known to superintendents and foremen that some men require much more time than others to do this work in which system and right methods are the great economizers.

CYLINDRICAL SURFACES.

THE general formula for obtaining the stretchout of cylindrical forms is 3 1-7 times the diameter. This is not strictly correct but many mechanics prefer to use it, as it is near enough for ordinary calculation. The correct formula, and one which the writer uses and advises is 3.1416 times the diameter; this gives the circumference of the circle, or as it is termed in plate work, the "stretch-out," By stretch-out is meant that length of plate on the flat, which, when rolled to shape will conform to and make up the required diameter.

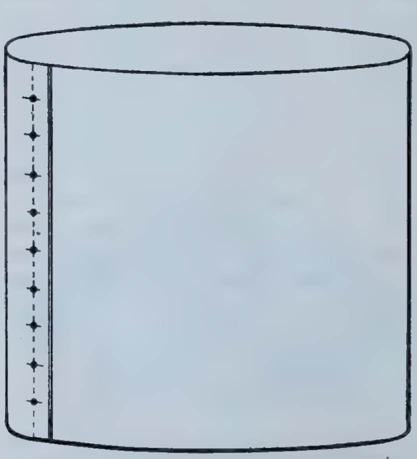


FIG. 1. NO. 22 GAUGE SHEET IRON CYLINDER.

Take, for instance, the cylinder of No. 22 gauge iron (about 1-32 in. thick), shown in the perspective drawing Fig. 1. In gauges lighter than No. 20, it is not usual to consider the thickness. To calculate by the fractional formula, the stretch-out will be 3 1-7 × dia. = 3 1-7 × 21 = 66 inches. The decimal formula gives 3.1416 × 21 = 65.97 inches. The first formula gives the length of plate 3-100 or 1-32 part of an inch too long. In this case, however, it is practically an infinitesimal quantity, but in the heavier gauges the thickness of the plate must be considered.

Effect of Plate Thickness.

During the operation of rolling, the outside circumference of the plate stretches, while the inner circumference compresses. These factors which are generally termed the "take up" or "loss in the rolls" have to be considered in calculating the stretch-out. They are usually overcome by working from the neutral line. For instance, in the plan view of the cylinder shown in Fig 2, the inside diameter is 20 inches and its inside circumference 20 × 3.1416 equals 62.83 inches. The outside diameter equals 20 in. plus 2 plate thicknesses, making 20 + (2 × ½) = 21 in. The outside circumference, therefore, is 3.1416 × 21 = 65.97 inches. As the inside circumference has been compressed and the outside stretched, it will readily be seen that the true circumference must be the mean of these values, or in other words the neutral circumference, which is $(62.83 + 65.97) \div 2 = 128.8 \div 2 = 64.4$, or 64 13-32 inches.

As the plan in Fig. 2 shows a butt joint, the length of plate required on the flat is 64.4 in., or 64 13-32 in. Fig. 3 shows a lap joint, therefore to the calculated length must be added the laps. A much quicker method than the above to obtain the stretch-out in heavy plate is by calculating directly from the neutral diameter. The neutral diameter in Figs. 2 and 3 is $20\frac{1}{2}$ in., therefore the neutral circumference is $20\frac{1}{2} \times 3.1416$, which equals 64.4 in., or 64 13-32 in. This is the same result as given by the longer method.

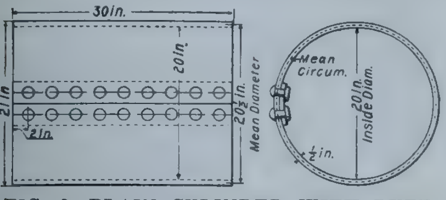


FIG. 2. PLAIN CYLINDER WITH BUTT JOINT.

A summary of the foregoing paragraphs shows that the stretch-out of light plate less than gauge No. 20 (1-32 in.) equals diameter multiplied by 3.1416, whilst the heavy plate is calculated by 3.1416 times the neutral diameter. In most operations, therefore, where thickness, bending, flanging and rolling are contended with, work from the neutral line.

The length of plate required for Fig. 2 is 64 13-32 in. Measure as on Fig. 4, this distance on the plate, bisect and square up as explained in previous article re squaring up*. Measure the line of rivet holes $1\frac{5}{8}$ in. from the butt edges and on this line A-B, mark off the two end rivets 2 in. from the top and bottom edges respectively.

Bisect this distance and, at each side of centre, mark off four equal spaces. Transfer all these hole centres to a lath and place lath on the opposite rivet line C-D, with rivet centre to centre of line C-D. Now mark off all the holes from the lath and use the same centres for marking off the butt strap. Fig. 4 shows the complete pattern with butt strap. The length of plate between the rivet line centres of cylinder shown in Fig. 4 is 64.4 or 64 13-32 inches. To this is added the laps or twice $1\frac{5}{8}$ inches, and the total length of plate required becomes $64.4 + 3\frac{1}{4} = 67\ 21\text{-}32$ in.

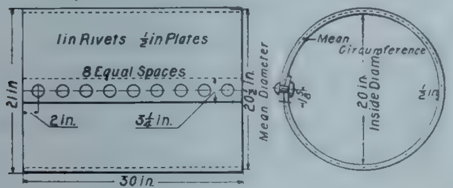


FIG. 3. PLAIN CYLINDER WITH LAP JOINT.

As shown in Fig. 4, measure off 64.4 in., the distance between rivet lines; bisect and square up the plate, and add $1\frac{5}{8}$ in. for laps to each end, thus making the total length 67 21-32 in. Bisect the rivet line E F and mark off the two end rivets 2 in. from top and bottom plate edge. Between the centre and one of the end rivets on line E F, mark off four equal spaces and transfer these by the lath method to the other side of the centre. Next transfer all hole centres to line G H, always bearing in mind that centre of lath must be kept to centre of rivet line. Fig. 4 represents the completed templet of the drawing shown in Fig. 3.

Where there are a great number of holes, the lath method of marking is a splendid time saver, and although this may not seem apparent when there are but a few holes to mark off, it still has the advantage of accuracy, interchangeability and uniformity, which are great factors in repetition work and even in odd jobs.

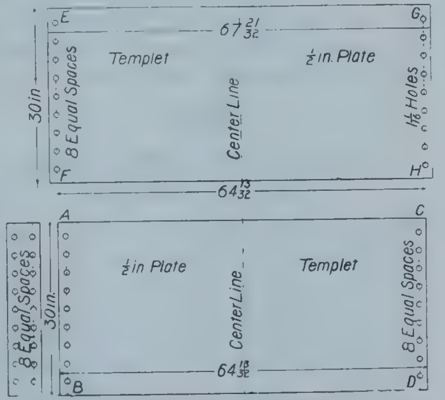


FIG. 4. COMPLETED TEMPLET OF CYLINDER IN FIG. 3.

In Fig. 5 is shown the plan and elevation of a number of plates connected together by the in-and-out system of cylindrical plating. That is to say, one series of plate courses fits inside, whilst the other series fits over or encircles the inner courses. With some modifications in laps, butts and riveting, the drawing shown may be utilized for such work as tanks, standpipes, air receivers, horizontal and vertical boilers, etc.

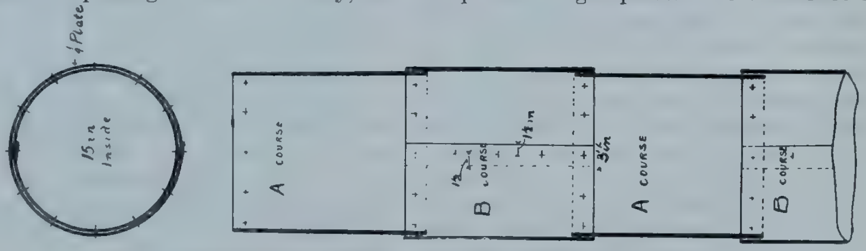


FIG. 5. IN-AND-OUT SYSTEM OF CYLINDRICAL PLATING.

The inside diameter of course A equals 15 in. and the neutral diameter will equal 15 + one plate thickness, making $15\frac{1}{4}$ inches. The neutral circumference (which is the length of plate required, ignoring laps) equals $15\frac{1}{4} \times 3.1416 = 48$ in. As the laps at each end of plate are $1\frac{1}{2}$ in. from the rivet line centre, the total length of plate for course A will be $48 + 1\frac{1}{2} + 1\frac{1}{2} = 51$ inches.

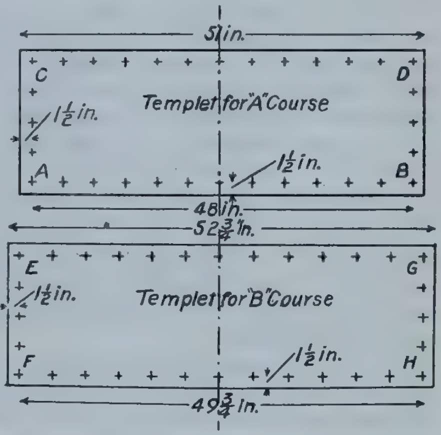


FIG. 6. TEMPLET FGOR A COURSE OF CYLINDRICAL PLATING.

Measure off, as shown in Fig. 6, 48 inches (which is the distance between the lap rivet centres), and mark off the rivet line A B, $1\frac{1}{2}$ inches from, and parallel to, this line. Bisect rivet line A B, and square up the plate, thus obtaining all the rivet lines. Mark off twelve equal spaces on the top and bottom rivet lines A B and C D; also divide the rivet lap lines A C and D B into four equal spaces, using the lath method as before. Centre-punch all the rivet hole centres and from these line centres mark off $1\frac{1}{2}$ inch laps. Strike in the lines with a chalk line or straight edge, and a few suitably placed centre punch marks will locate the shearing edge in case of the chalk lines being obliterated. This completes the templet for course A, and is as shown in Fig. 6.

As course B fits over or encircles course A, it will be obvious that it will require a longer plate. The difference in length depends upon whether a tight, easy or slack fit is desired, according to the nature of the work. In boiler and tank work it is essential to have tight fits; that is, the metal should be brought together as closely as it is possible to be drawn. Smokestack and similar work is generally easy fitting, and thus permits easy, economical assembling.

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*Page 3, Vol. 12, July 2, 1914.

The inside diameter of course A is 15 inches and its outside diameter will be 15½ in., while the inside diameter of course B will be the same as the outside of course A, which is 15½ inches. The outside diameter of course B will then be 16 inches and its neutral diameter 15¾ inches, or two thicknesses more than the neutral diameter of course A. The neutral circumference of course B will be 3.1416 × two plate thicknesses more than course A. This is more generally calculated, 6.2832 times one plate thickness, equals 6.2832 × ¼ = 1.57 inches. Course A circumference = 48 in., therefore course B will equal 48 + 1.57 = 49.57 in., or 49 17-32. This calculation gives a good tight fit for boiler and tank work, and permits the plates to be well drawn together, thus ensuring good riveting and calking.

As will be seen, the method of calculating the outer course is to obtain the neutral circumference of the inner course and add to this 6.28 times the plate thickness, which gives the stretchout of the outer course. This calculation is for a tight snug fit. If a tight fit is not essential, the formula 6½ times the plate thickness is added, and again, in the case of quick and easy assembling of the courses, the formula generally used is 7 times the plate thickness.

To sum up the foregoing, the result is that 6.28 times plate thickness for good steam or watertight work, 6½ times plate thickness for easy fit, and for slack fit, 7 times the plate thickness have to be added to the neutral circumference of the inner course.

It is required to make course B a slack fit, therefore the length of plate between the line of rivet hole centres will be length of course A plus 7 times plate thickness. This equals 48 + (7 × ¼) = 49¾ inches, to which must be added the laps. Therefore, the overall length of course B equals 49¾ + 1½ + 1½ = 52¾ inches, including laps.

Measure off on the plate, as in Fig. 6, a distance of 49¾ inches and parallel to this, mark off the rivet line 1½ inches distant. Bisect this rivet line F H and square up the plate. At each side of centre of F H rivet line, mark off four equal spaces and transfer all holes to line E G. Mark off lines E F and G H in a similar manner.

It will be noticed that as course B is longer than course A, the rivet spacings on E G and F H, Fig. 6, are slightly further apart than on C D and A B, although the holes are spaced equally in their respective courses. As in Fig. 6, mark off the shearing lines 1½ inches from the rivet centres. These templets may be used for marking any number of plates required.

After the necessary operations have been performed on the plate, and it is ready for assembling, care should be exercised to keep the laps looking in alternate ways as shown in elevation and plan view in Fig. 5.

* * *

MUCH POWER EXPORTED.

THAT more of the immense electrical development of Canada is exported from the country than is used at home is shown by figures just compiled by the Government dealing with electrical inspection. The production, export, and domestic supply of the principal companies on the basis of kilowatt hours are:

	For Export.	Home Use.
Can. Niagara Co.	400,214,908	11,420,020
Electrical Dev. Co.	42,154,000	191,885,670
Ontario Power Co.	282,123,004	412,597,896
Ontario Minn. Co.	21,649,327	868,856
Western Canada Co.	23,213,891	39,339,239

The total production of electrical power last year was 1,543,464,097 kilowatt hours, of which 772,597,049 was exported from and 770,867,048 used in Canada.

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CONCERNING A DELIVERY PENALTY CLAUSE.

BECAUSE they failed to deliver certain machinery to the Canadian Rubber Co. by the time called in their contract, in which a penalty clause was inserted, the Canadian General Electric Co. have lost $14,500 by a judgment delivered in the Court of Review. The amount in question covers a delay of more than a year at $25 a day. In appealing to the Court of Review from the judgment given by Mr. Justice Charbonneau of the Superior Court, counsel for the Canadian General Electric Co., claimed the contract in question had been withheld from them until it was too late to fulfil its conditions, and that therefore Mr. Justice Charbonneau's judgment should be set aside by the Court of Review. Their Lordships Tellier, Greenshields and Delorimer, sitting in the latter court, upheld the decision given by Mr. Justice Charbonneau, adding that the acceptance of the contract by the Canadian General Electric Co. and their attempt to fulfil it implied acceptance of all its terms.

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ONTARIO HYDRO-ELECTRIC FIGURES.

IF anything were needed to demonstrate the remarkable success of public ownership as exemplified by the Hydro-Electric System it is offered in the returns of the municipalities in the Hydro sphere for the first nine months of the year. The financial statements of 40 municipalities, made public in brief form showed an unbroken succession of surpluses, and this in spite of the prevailing depression, and the fact that the three months of heavy consumption—from October 1st to the year end—are not covered. The surpluses are evidence also that the Provincial Commission, in recommending general reductions in power rates at the beginning of the year were not giving the municipal systems too much of an impost to bear.

The Statement.

The following statement shows the net surplus, after allowing ample amounts for depreciation, interest, power charges, etc.

Municipality.	Gross surplus.	Depreciation.	Net surplus.
Ottawa	$28,144.05	$26,470.40	$ 1,673.65
Hamilton	28,213.73	16,000.00	12,213.73
London	48,289.16	21,222.00	27,067.16
Berlin	15,391.24	8,872.00	6,519.24
St. Thomas	19,344.64	5,319.00	14,025.64
Guelph	19,174.18	7,705.00	11,469.18
Stratford	9,813.58	4,074.00	5,739.58
Galt	15,325.64	6,945.00	8,380.64
Woodstock	8,891.41	4,014.00	4,877.41
Collingwood ...	4,009.12	1,983.00	2,026.12
Barrie	4,442.94	2,647.00	2,095.94
Ingersoll	5,797.41	2,587.00	3,210.00
Waterloo	5,366.58	2,616.00	2,750.58
Dundas	3,928.77	1,900.00	2,028.77
Preston	4,631.94	2,450.00	2,181.94
Penetang	1,632.04	1,449.00	183.04
St. Mary's	4,369.64	2,450.00	1,919.64
Brampton	4,097.69	2,250.00	1,847.69
Tillsonburg	2,408.07	1,380.00	1,026.07
Weston	2,845.92	1,050.00	1,795.92
Milton	5,332.78	750.00	4,582.78
Mitchell	1,954.17	900.00	1,054.17
Elmira (10 months)	1,070.60	563.00	507.60
Norwich	1,214.05	413.25	800.80
Georgetown	1,923.24	591.00	1,332.24
New Hamburg..	2,564.15	675.00	1,889.15
Acton	546.99	415.00	181.99
Stayner	175.27	262,50	87.23
Hagersville	591.59	314.00	277.59
Baden	1,128.00	215.00	913.00
Caledonia	427.03	225.00	202.03
Coldwater	801.02	300.00	501.02
Pt. Stanley	2,122.04	507.00	1,615.24
Elmvale	457.83	255.00	202.83
Waterdown	689.33	304.50	384.83
Rockwood	821.34	210.00	611.34
Beachville	1,877.90	300.00	1,577.90
Port Credit	1,123.33	394.80	728.53
Thamesford	414.95	119.00	295.95

The statement given does not contain the figures of municipalities that have been operating, but a part of the nine months' period, and the Toronto returns are also missing. These have yet to be finally passed upon, and are the subject of discussion between the officials of the Toronto and Provincial Commissions.

The City of London makes the best showing of the list, a net surplus of $27,067 being reported for the nine months. St. Thomas, Guelph and Hamilton showed margins above the ten thousand mark.

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Presentation.—Recently the employees at the Beach pumping station, Hamilton, gathered at the works, where a presentation was made to Harold Hayes, one of their number, who is going to the front with the second contingent. Mr. Henderson made the presentation, and James Bain, chief engineer, spoke a few words of farewell. Mr. Hayes replied suitably and thanked them for the kindness all had showed him.

Relative to Steam Pipe Arrangement in the Power Plant--II.

By G. W. Sutcliffe, Wh. Sc.

This writing is a recapitulation of the principal matter contained in a series of articles, the compilation of which was the result of observation and experience derived from the inspection and other records of the Vulcan Boiler and General Insurance Co., Manchester.

IN part I of this highly important subject, which appeared in our October issue, the features of Drainage of Water, Pressure and Temperature, Pipes and Pipe Flanges, were discussed at length.

Expansion Joints.

Expansion Movements.—These may be allowed for by the provision of suitably disposed elbows. Incidentally pipes thus arranged possess special advantages in regard to erection. In some cases, stuffing boxes or metallic surfaces are arranged for permanent rotary movement with the same object. Expansion or contraction due to changes in temperature may reach one foot in five hundred in the case of saturated steam, or one in three hundred in the case of superheated steam. In either case, one-half may be allowed to take effect in compression and the other half in expansion, whereby the maximum resulting stress is also reduced by one-half.

Stuffing Box Sliding Expansion Joints.—These are successful, but they must be constructed to prevent blowing out at gland; also to prevent water-logging at gland and setting fast by corrosion. Double stuffing boxes may be arranged to balance and supersede the use of tie rods.

Flexibility of Steel Pipes.—This is most useful in yielding to expansion and in facility of erection. Steel coils are particularly effective in this way.

Automatic Steam Trap.—A trap of this description should be provided for the drainage of each separate section, and so that the drainage of any point in the system shall be incapable of interruption as by the closing of any stop valve .

Pipe Joints.

Pipe Joints.—These are usually made with paste or putty. This should not exude into the steam space, and the paste is more securely kept in position by corrugated metal rings or other equivalent means. Sometimes joints are made with compositions prepared in large sheets, from which the joint ring may be cut out to any form desired. In screwing up care should be taken to prevent crowding the joint material around the studs, as this prevents the two flanges from coming into close pressure contact. Narrow rings give better pressure on the joint, but they involve a cross bending force on the flange which has occasionally led to serious accident. Sometimes flanges are recessed in pairs, and in this way the adjoining pipes are kept in accurate alignment and the rings prevented from blowing out. In special designs of pipe joints many failures occur by reason of their inability to withstand rough usage.

Leakages. — All leakages, however small, should receive immediate attention. Generally the joints should be cleaned off at once and made anew. It is usually impossible to stop even the smallest leakage by the application of any reasonable amount of force upon the bolts, and any attempt to tighten a leaky joint under pressure is attended with extreme danger.

Pipe Supports.

Supports for Pipes.—The best support for pipes is afforded by suspension rods attached to special clips, fitted with spring and with adjusting screw. Vibration is promoted by uniformity in length of suspension or multiples thereof; it is checked by irregularity in same, and prevented by stays. Vibration may also be caused by pulsation in steam current. In some cases supporting rollers are adopted either to roll upon level ways or to rotate upon axle ends. Such rollers are carried in frames, which may be arranged to stand upon the level surface of a bracket, or to suit the top of a column. Means should be adopted to minimize loss of heat in all details adopted for support of pipes. Definite instructions should forbid the use of pipes as supports for ladders, stages, etc.

Barometric Elevation of Water.—This may lead to serious accident, and should be prevented by the use of an automatic vacuum breaker. In such an instrument a displacer-float heavier than water is used with a counter-balance and to work without friction. Such danger is mostly incurred when crawling the engine around, or with a leaky feed-heater in the exhaust pipe.

Valve Types.

Types of Valves.—Stop valves inserted in a straight line of pipe are generally one of two types. The first is the plain screw-down type with the stopway across the centre line, involving a tortuous passage for steam. The second is the gate type, with the centre line of the stopway placed along the main centre line of the pipe. In the screw-down type, the screw thread should be placed outside the casing. Valves of gate type give a straight course of uniform area, and, therefore, minimum resistance; but they occupy a large amount of space, and possess large surface for loss of heat by radiation. The surfaces of the seatings and valve pieces are subject to much friction, and the opening or closing is a lengthy operation. A stop valve is sometimes required in a high position and to be actuated from a lower position. This could be met by an inverted valve, with the spindle continued downwards, but a much better arrangement is obtained by a spindle in usual upward position, driven by a pair of spur wheels and a vertical side shaft.

Junction valves usually take in the steam by a bottom branch, and deliver it by a side branch. The course of the steam through the valve is somewhat tortuous, but less so than with the straight line screw-down type. The fittings of the junction valve are practically identical with those of other screw-down types.

Auxiliary or by-pass valves are used to equalize the pressure above and below the main valve, and thereby to facilitate the movement of the main valve; also to pass small quantities of steam for warming. .These should always be provided as a separate valve outside the main casing. Valve spindles are usually of gun metal, which is subject to derangement by expansion due to temperature, and various devices are adopted to compensate for this. In all cases, during raising of steam, the valve spindle should be frequently tried and kept free from jamming.

Valve Details.—Seatings and counterparts should possess ample strength, stiffness, and hardness whereby to resist presure, distortion or abrasion. For such purposes, gun metal has been largely used, but it now largely replaced by special alloys.

Isolating Valves.—These effect automatic separation of boilers to secure the safety of men who may be engaged in the boiler at time of an accident to pipes. Incidentally, improvements are also effected in regard to uniformity of working the boilers. A junction valve may be modified to act as an isolating valve.

Hydraulic Test.—All pipes and valves should be tested by hydraulic pressure. Generally this test should be double the working pressure, or to 100 lbs. above the working pressure. This should be maintained not less than ten minutes in each case, and the work kept under continual observation.

Steam Pipe Design.

Design of Steam Pipes.—Steam pipes should be designed to secure high efficiency in regular work. Closing lengths should be made to dimensions taken after all other pipes are fixed. To allow time for this, a temporary pipe may be adopted of reduced diameter, but complete reliability in regard to general safety and freedom of drainage must be assured. Accurate drawings showing lines and levels of pipes should be prepared in every case. Parallel, horizontal, vertical and right-angled lines for pipes should be adopted as far as possible. Fittings and other objects should be avoided and means of convenient access provided throughout. Pipes, stages, etc., should not cross gangways. The most dangerous levels of such obstructions are below one foot height from the floor and between the heights of 5 ft. and 6 ft. 3 in.; also any level within reach in dark positions. Sand and foreign matter generally should be thoroughly removed from all steam spaces, and a final cleaning effected by blowing steam through them after closing up.

Preventing Heat Radiation.

Heat Radiation and Non-conducting Coverings.—Loss of heat by radiation from exposed heating surfaces of pipes, etc., is continuous. The amount lost principally depends upon the amount of surface exposed and the temperature of such exposed surface. The amount of loss is susceptible of important reduction by the use of non-conducting coverings, the efficiency of which as a rule is roughly proportionate to the quantity of air which exists finely diffused in the materials, and also to the fineness of diffusion. Air posseses low conducting power for heat, but is freely transparent to the passage of radiant heat rays, and is subject to convection. For these reasons the use of jackets or belts containing free air is never attended with success.

A crude plastic covering is principally of clay, with organic material, principally fibrous, to hold it together until dry, or to improve its insulating power. This never gives good results.

Slag wool is attended with a variable amount of success. It is liable to disintegrate under vibration, and to shed globular dust which is objectionable in proximity to bearing surfaces, etc.

Magnesia, with sufficient asbestos to hold it together, is a good composition.

Pure asbestos is one of the best insulators available, but it is not easily applied, and its cost is high.

Mica of suitable quality is very efficient.

Each of the best materials is liable to admixture with other matter. In some cases the admixture may be beneficial; in others perhaps neutral, and in the majority distinctly prejudicial to efficiency, since the principal object of admixture is to increase the weight. Incidentally, the amount of surface covered per ton is reduced. Combustible matter is useless for high temperatures.

The non-conducting covering should extend over the whole of the heated surfaces and be of ample thickness. Also the application should be carried out with due regard to future necessity for access to the various parts of the work. The use of superheated steam increases the necessity for good coverings.

As an example of heat loss from radiation it may be stated that the heat loss of one pair of ordinary flanges for a 10-inch pipe freely exposed to the air while under a pressure of 200 lbs. is in twelve months equivalent to about $5 with saturated steam, and to about $8 with superheated steam. Non-conducting compositions should be protected against abrasion by painting and varnishing, or by steel sheets, or by canvas. Steel covers should not be allowed to come into contact with hot flanges, etc.

The Successful Design of Worm and Screw Drives*

By Helix

A worm or screw drive was, until quite recently, looked upon as an inefficient, power-consuming arrangement, the use of which should be avoided wherever it was possible to employ any other form of transmission device. Even at the present time there are many people who look with suspicion on any form of screw drive.

IF a worm or screw drive made fifteen or twenty years ago be closely examined it can be quite easily understood that a great deal of power would be wasted by its use, and that, notwithstanding an almost unlimited application of oil, considerable friction and wear would be inevitable. It is also unfortunately true that some modern designs display a woeful lack of knowledge on their designers' part of the fundamental principles of successful worm and screw design.

It should be remembered that inefficiency and lack of durability are practically synonymous terms, so that inefficiency almost inevitably results in a high rate of wear. A moment's consideration will show why low efficiency means that of the power put into a machine or mechanism only a comparatively small proportion is actually taken out in the doing of useful work. This being the case, it is perfectly evident that the power lost has been dissipated in its transmission, and the only way in which it can be so lost is in overcoming the friction of the sliding parts.

Friction is the chief cause of wear; therefore, if the frictional resistance is unduly high it will probably be found that the rate of wear will be very high also. Even if the actual visible wear is not very great, the tendency to wear will be. It will, therefore, be recognized that the power lost is really worse than wasted, because its only function is to wear out the sliding elements of the mechanism. It was on account of the low efficiencies obtainable in the designs then available that the worm type of drive was held in such small favour in the past.

The efficiencies were so low that probably in a large majority of cases by far the greater proportion of the power transmitted was dissipated in overcoming friction, with the result that the parts were very soon worn out. That this state of affairs is not necessarily inevitable is now generally recognized, and it is also more or less apparent that the failure of the early designs was due to a failure to understand the main principles upon which depend the success of this form of drive.

Present-day Experience.

In the light of more recent knowledge of the subject, it is now quite legitimately claimed that so far as efficiency is concerned, a correctly designed and accurately made worm drive is practically as good as any other form of drive; while for smoothness of action and comparative noiselessness of operation, it is probably one of the best in existence. A proof of this is to be seen in the extensive adoption of worm-driven rear axles for motor cars in place of the now nearly obsolete bevel gear drive. It will be admitted that the durability and efficiency of the worm drive must be above reproach, to merit its adoption in such examples as the one quoted. It should, therefore, prove of interest to discuss in a rather elementary way the essential requirements of a successful worm or screw drive; but, before proceeding further, it may be best to briefly explain some of the definitions used, so that a clearer understanding of what follows may be obtained.

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*In Page's Weekly.

Worm Definitions.

Fig. 1 shows a worm having a right-hand single thread. The linear or axial pitch P is the distance from a point on one thread to a corresponding point on the next thread, measured parallel to the axis. The normal pitch N is exactly similar to the axial pitch, except that it is measured normal (that is, at right angles) to the thread. The pressure angle or angle of obliquity D is the slope of the sides of the thread taken on a section through the axis. This pressure angle varies from nothing in the case of a square thread to 30 or more degrees. The standard in most general use is without doubt that of the Brown & Sharpe Co., which is 14½°, but some firms are now adopting a 20° standard, while others again favor 22½°. The helix angle B is the angle the thread makes at the pitch circle normal to the axis.

A single thread worm is one in which there is only one thread, which is continuous; while a double or multiple thread worm has two or more separate and distinct threads. The lead is the distance a point on the pitch circle circumference of the worm gear would move in one revolution of the worm. In a single thread worm, the lead and axial pitch are equal, while in a double or triple thread worm the lead is two or three times the axial pitch respectively. A useful rule to bear in mind regarding the hand of worms and screws is that a right-hand screw advances through its nut when turned in a clock-hand direction. The co-efficient of friction is the ratio of the pressure (between two surfaces) to the force required to slide the two surfaces on each other. A frictional co-efficient of .1 means that the force required to cause sliding between two surfaces will be .1 times the pressure between those surfaces.

Successful Worm Design.

Having stated some of the most important definitions, we are now better able to make clear the requirements essential to successful worm design, and since the action of a screw thread is practically identical with that of a worm thread, most of our conclusions will also be equally applicable to the design of screws. To secure the highest efficiency, without doubt the most important requirement is a large helix angle (as near 45° as possible), and since this angle varies inversely, as the diameter of the worm and almost directly as the lead, it follows that the diameter should be as small and the lead as large is possible.

Fig. 2 shows a single thread worm, ½-in. lead, 6-in. diameter, while in Fig 3 a 2-in. diameter, 2-in. lead quadruple thread worm is represented. In one revolution of the latter the worm gear would be turned through 4-N of a revolution (N being the number of teeth in the gear), while the larger worm would have to make four revolutions to turn the gear an equal amount. Referring to Fig. 4, we have the circumference of the larger worm straightened out, AB being the helix and EF the circumference. Similarly in Fig. 5, CD is the helix of the smaller worm and GH the circumference.

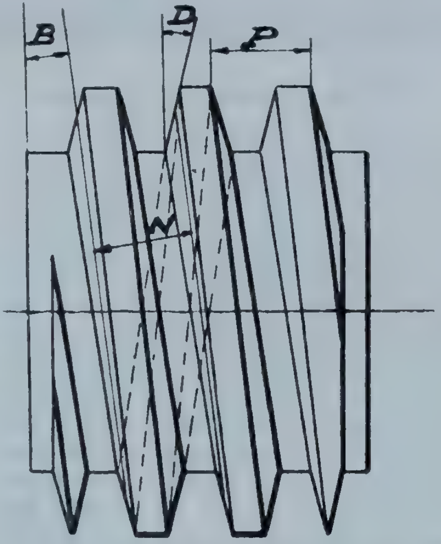


FIG. 1. RIGHT-HAND SINGLE-THREAD WORM.

It is evident that in four revolutions of the larger worm the length through which sliding has taken place will be four times AB (Fig. 4), while to accomplish similar results with the smaller worm (that is, move the gear through 4-N of a revolution), sliding has only operated through a distance of CD (Fig. 5), obviously a much shorter dimension. Though the normal pressure between the thread of the worm and the teeth of the gear is somewhat greater with the smaller worm, the losses due to friction will be considerably less than with the larger one. It must also be pointed out that exactly similar reasoning applies to the end thrust friction, so that a large helix angle proves of benefit in two ways.

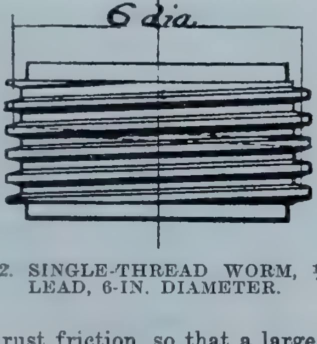


FIG. 2. SINGLE-THREAD WORM, ½-IN. LEAD, 6-IN. DIAMETER.

The actual efficiency for each of the two arrangements (not including the end thrust) would be about 85 per cent. and 35 per cent. for the smaller and larger worms respectively, but with the end thrust included, these efficiencies would be reduced to 75 per cent. and 24 per cent. This means, of course, that the frictional loss is 76 per cent. in one case and 25 per cent. in the other; obviously a saving well worth effecting if conveniently possible.

Anti-Friction Thurst Bearing.

Another important element in worm design is the provision of an anti-friction thrust bearing of the ball or roller type. Twenty years ago, ball or roller bearings were not as reliable as at the present time, while they certainly were not made in such a widely adaptable range of sizes. There can now be no excuse under this head, as ball or roller bearings can be obtained in practically any size, while their load-carrying capacity and reliability can be definitely depended upon. That a ball or roller thrust is of great importance is shown by the two sets of efficiencies given above relating to the worms shown in Fig. 3 and 4. Neglecting end thrust, these efficiencies are 85 per cent. and 35 per cent., while the end thrust (assumed to be taken on a bearing of the ordinary collar type) reduces them to 75 per cent. and 24 per cent. respectively. Since ball thrusts are practically frictionless, it naturally follows that in the examples given the loss of efficiency due to the end thrust would be almost entirely saved by the use of anti-friction thrust bearings.

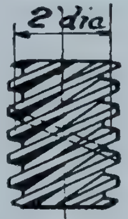


FIG. 3. QUADRUPLE THREAD WORM, 2-IN. DIAMETER, 2-IN. LEAD.

It should also be noticed that whereas with the wide angle worm a tall thrust only increased the efficiency by slightly more than one-eighth, in the other example the increase is from 24 per cent. to 35 per cent.—that is, nearly 50 per cent. It may, therefore, be stated as a general rule that the lower the efficiency of the worm the greater the need and effectiveness of a ball thrust.

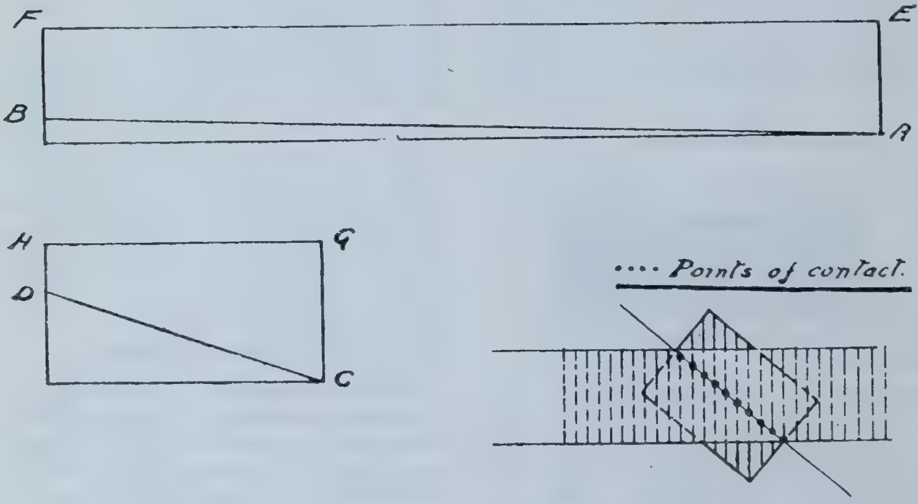
The Co-efficient of Friction.

The third important consideration in worm and screw design is the co-efficient of friction. Since, as previously mentioned, all the transmission losses are due to the overcoming of frictional resistance it is obviously necessary to arrange the design so that the co-efficient of friction will be as small as possible. The contact surfaces of the gear and worm—that is, the teeth and thread—should be as smooth as possible, while the load-carrying capacity should be great enough to ensure that these surfaces will not cut up or seize when under load. The materials from which the worm and gear are made have also some influence in this direction, and the combination most generally used seems to be phosphor-bronze for the gear and hardened steel for the worm, the latter in many cases being ground on the thread after hardening.

Lubrication.

Another item, possibly even more important than the question of materials, is the thorough lubrication of the worm and gear. By thorough lubrication is meant that which provides a film of oil between the sliding surfaces, a condition which should be met by all lubrication if the best results are desirable. To allow of this, the surfaces must, as stated, be perfectly smooth, and the tooth curves correctly formed. The latest experiments seem to suggest that a greater obliquity angle by giving flatter tooth curves, increases the area of contact and, as a result, allows of more efficient lubrication. It may be mentioned that the hollow face worm wheel with hobbed teeth was introduced to give a greater area of contact. Though the contact is, theoretically, only a point, it is reasonable to assume that its area is considerably greater than if the worm wheel teeth were not cut to embrace the worm more or less intimately.

It has, however, been claimed that one of the most efficient types of worm drive is that in which the worm shaft is set round at an angle equal to the helix angle, thus allowing the worm to engage with a straight and spur gear. An adaptation of this idea is used in the well-known Seller's drive for planing machines, the table rack being driven by a worm. Fig. 6 is a sketch diagram of such an arrangement, particular attention being drawn to the fact that the cutting pressure is distributed over several teeth, while the wear is equally distributed over the full width of the rack face. With a correctly designed, effectively lubricated worm drive the wear is very small indeed, because, practically speaking, there is scarcely ever an actual metal to metal contact on account of the film of oil.



FIGS. 4, 5, 6. DESIGN OF WORM AND SCREW DRIVES.

Highest Efficiency Fundamentals.

The fundamental requirements, then, to secure the highest efficiency may be enumerated as follows:—

(1) The helix angle should be as large as possible up to 45 degrees; (2) the worm diameter must be small and the lead large; (3) the worm gear should be of phosphor-bronze; (4) hardened steel worm with thread ground after hardening; (5) the drive should be totally enclosed and run in oil; (6) axial thrust of the worm taken on a ball bearing; (7) to give maximum contact area the wheel should be either hollow face and hobbed or else a spur gear with the worm swiveled as in the Seller's drive. With the exception of 3, 4, and 7, these requirements are equally necessary in the successful design of screws.

Limitations of space prevent a complete treatment of the subject; the various types and styles of designs have hardly been touched upon, while the methods of manufacture have been entirely ignored as outside the scope of the present article. It is, however, hoped that sufficient has been written to at least indicate the requirements necessary to efficiency, and if the ideas outlined are closely followed no doubt reasonable success is assured—in any case the features enumerated can be taken as fundamental foundations on which can be constructed economical and efficient worm or screw drives.

OIL THROWN FROM BEARINGS.

THE trouble caused by a motor throwing oil from the bearings is generally caused, says a writer in the Electrical Review and Western Electrician, by the rings picking up so much oil from the well and carrying it on to the shaft that it is impossible for it to leave the latter by means of the lubricating oil grooves fast enough. The oil will then creep along the shaft until outside the bearing housing, where the centrifugal force will throw it off in small drops or as spray. Manufacturers use various means to eliminate this, one of the most common being to cut a groove about one-eighth to one-quarter of an inch wide, and correspondingly deep, in the bearing near the ends. A hole is drilled through this groove in the bottom of the bearing to allow the oil to escape as it is collected on the shaft. Very often, however, this groove is not cut deep enough, or the hole in the bottom groove may be plugged up with dirt, waste, etc., and cause oil-throwing. The groove should be cut deeper and the hole cleaned or drilled out a little larger in this case. It may sometimes be necessary to drill an additional hole in the bottom and cut the groove as deep as the metal will allow before the oil-throwing is stopped.

* * *

Fuel Economizers.—A paper on the counter current principle as applied to directly fired and to waste heat boilers appears in a recent number of the Journal of the Engineers' Society of Pennsylvania. It discusses at some length the conditions under which fuel economizers should be installed and those under which the use of waste heat boilers is economical. The conclusions drawn by the author, George H. Gibson, of the George H. Gibson Co., New York City, are that economizers can be used profitably regardless of the fuel price and load factor as, if an economizer be not used, the boiler must heat the water up to the evaporation point at a lower efficiency, since it contains water at the temperature of steam, while the economizer utilizes the low initial temperature of the water to increase the heat absorption. Waste heat boilers and turbines should be put in for as high steam pressures as are practical, in view of other considerations, and the boiler should be supplemented by an economizer to obtain the maximum power from a given amount of gases.

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Escher Wyss & Co., of Montreal, have been awarded the contract for two 2,250-h.p. water wheels with accessories by the Hydro-Electric Power Commission of Ontario for their new hydro-electric power plant at Eugenia Falls. These wheels work under a head of 540 feet running at 900 r.p.m.

Internal Combustion Engines

DEVELOPMENT OF THE MODERN GAS ENGINE.—I.*

By J. Edward Palmer.**

THE operation of the modern gas engine may reasonably be expected to be eventually made nearly as reliable as that of the operation of the steam engine, provided continuous thoughtful consideration is given to the design, the construction and the supervision of all features of development of the first-named type of prime mover. In this monograph the general term gas engine is intended to include all appliances in which power is generated by explosive rather than by continuous-pressure action. This belief is founded upon the fact that there are now thousands of thoughtful and able designers at work upon giving to the world an improved gas engine, and as the result of such continuous efforts the appliance ought to develop into a more reliable and efficient machine, as well as one whose first cost would be very materially reduced from the price now charged for such construction.

This statement may appear surprising to many people, because in their own experience they have probably observed that the gas engine can be thrown out of commission from comparatively small troubles. The impairments of the gas engine likewise often involve excessive expense and time in overcoming such defects, due to the fact that comparatively few people have even a fair knowledge of the salient principles governing the design and operation of such motors.

Reliability of Action of Gas Engine.

The maintenance and operation of the steam engine is so familiar to tens of thousands of people that the ordinary impairment of such an engine can be quickly overcome even by those who have had but comparatively little engineering training and experience. The steam engine in practical use, therefore, may be regarded as substantially a reliable appliance for maritime and industrial needs, and it will not be many decades before the gas engine may be a formidable rival to the steam engine for carrying on special activities.

In order to show the conditions requisite for the reliable operation of the gas engine it only ought to be necessary to tell in a very general way of those features that are of controlling importance in the operation of such type of machinery and of the ordinary impairments that are likely to take place. Under certain conditions the gas engine even now is a reliable appliance, and this statement may be attested by the fact that tens of thousands of automobiles are operated by persons who are not acquainted even with the elements of the mechanical principles of design that enter into the consideration of such machinery, nor even of some of the precautions that should be exercised in its operation. The machinery of automobiles ,however, is exceedingly well built, efficiently assembled, thoroughly tested, carefully protected and installed in a manner that does not invite the tinkering of those who are unfamiliar with the principles of its operation .

Probably the best way of noting wherever particular advance in the improvement of the gas engine can be made, as well as in showing how readily such machinery can be efficiently and reliably operated by those having even a cursory knowledge of the principles of such mechanism, would be to tell of the essential features of such appliances, together with some of the difficulties that are encountered in their operation.

Valve Gear.

The simplest and most reliable design of valve gear now installed on a gas engine is that where the cam shaft is operated by two gear wheels from the crank shaft, with the valves either directly over the cam shaft and lifted by push rods, or with the valves installed in the upper part of the cylinders and operated by means of working beams from the push rods.

Oiling System.

In general, the most efficient oiling system so far devised is the combination of forced feed and splash. The oil reservoir in this design is installed in the bottom of the crank case. The oil is forced through the system by an oil pump to each of the main crank-shaft bearings, and then finds its way into small curved suspended oil troughs placed under each connecting-rod end. These troughs are shaped like an arc of a circle, the centre of which is the centre of the crank shaft, thereby permitting the connecting-rod ends to dip the same depth into the oil. The sides of the troughs are arranged so as to give the best depth of oil. The oil is spread through the crank case to the cylinders, and finds its way back again into the reservoir at the bottom of the case, and can thus be used over and over again.

Carburetor.

The carburetor should be of the simplest form. There should be no springs or complicated mechanism to get out of order easily. It should have only a float, spraying nozzle, throttle valve, extra air valve to operate when throttle has opened a certain distance, and a gasoline-controlling needle valve between the float chamber and spraying nozzle. This valve is most important; it is used to regulate the supply of gasoline for changes intemperature, atmosphere and speed, and must be arranged to be easily operated. If operated properly it keeps the explosive mixtures of the proper proportions, which economizes fuel and prevents excessive formation of carbon in the cylinders. The air-intake pipe should be arranged to take hot air from around the exhaust pipe, and a strainer should be placed on the gasoline supply pipe to collect all dirt, dust, etc. With this style of carburetor there should never be any carburetor troubles.

Magneto.

The modern high-grade magneto is a very reliable appliance. The magnetos on the buses in London run for more than 30,000 miles without attention except using a few drops of oil every 500 or 1,000 miles and keeping them clean and free from dirt, dust, oil and water. Too much stress cannot be given to the necessity of fitting the magneto with a cover which will protect it from all oil, water and dirt. On a small engine which can easily be cranked by hand, it is suggested to do away with all batteries and dual ignition systems, and use only a high-tension magneto with a fixed spark advance of a well-known reliable make. Add to this mica spark plugs and a cut-out switch, and we have all that is necessary for a perfectly reliable system of the simplest form.

---

*From a paper before the American Society of Naval Engineers.

**Commander, U. S. Navy.

Fixed Spark.

The fixed spark is, of course, a compromise, and does not give the greatest economy at all speeds. On a small engine, the difference is slight, but the advantage gained in simplicity and ease of operation more than outweighs the small difference in economy. Considering likewise the hard usage small engines receive, and as they are often operated by inefficient and careless men, the fixed spark is considered the best all around arrangement. The intensity of the spark depends on the speed of the engine, and this to some extent makes up for the doing away with the changing of the spark advance. At low speeds when the intensity of the spark is less, the ignition and explosion of the charge is slower; and with greater spark intensity at high speeds, the ignition is faster. Thus, with a fixed spark we get the same effect, but not in quite so marked a degree as when altering the advance.

Gasoline Motor Troubles.

The great majority of failures and troubles of the gasoline motor are traceable to the unreliability of the batteries, whether either of the dry-cell or storage batteries. All types of batteries are continually giving out or growing weak without warning, whether in use or standing idle, so that constant care and watching are necessary to keep them in efficient condition. It is often difficult to obtain fresh dry cells as well as to maintain storage batteries properly charged, and as long as batteries are used there will arise complications as regards spark coils, multiplicity of wires, timers, etc., all of which are liable to get out of order and cause an endless amount of trouble.

By adopting the high-grade fixed-spark magneto, we at once eliminate the above difficulties and obtain an ignition system which is at once simple and reliable. Such a magneto will run for years with no repairs, if properly cared for. The engine will be found easier to start, and we have a spark of highest intensity at the instant the charge is fired. In the case of a changeable-spark magneto, the advance is altered by the operator at will, or by an automatic governor attached to the magneto. It is practically impossible for the operator to keep the changeable spark at the proper point for all conditions, so that, when using a changeable spark, it is really a matter of guess-work. It is claimed that the governor efficiently subserves this purpose; but, even if it does, which is not at all certain, the extra complications and liability to derangement more than offset the small amount of economy gained; consequently, the fixed spark is by far the best for small engines.

The "Fixed Spark" Explained.

In the operation of the gasoline engine, the compressed charge is fired by a "spark" just before the piston reaches the top of the stroke, and at a point that will allow the charge to become fully ignited, so that the full force of the explosion will be given just as the piston starts down on its power stroke. This is necessary, because it requires time for the charge to become fully ignited. The time required to affect complete ignition depends on the size of the cylinders, the compression, the temperature of the charge and the intensity of the spark.

The point at which the spark fires the charge is called the "advance," and this advance should be changed for different speeds. When batteries are used, the intensity of the spark remains the same, no matter what the speed of the engine may be; consequently, it is absolutely necessary that only inappreciable and even zero advance be given when starting, or else the motor will turn backward and thus cause a "kick back." As the speed of the engine increases, the advance must be correspondingly increased in order to maintain the efficiency of engine by causing the charge to be fully ignited, as shown above, when the piston just begins its power stroke. There is, therefore, nothing to guide the operator in changing the spark advance, except his judgment as to whether the engine is running properly or not. When a fixed-spark magneto is used, the best advance at which to set the spark must be determined by trial, and once the magneto coupling is clamped in position it should not be altered. It will thus be seen that the fixed-spark device entirely eliminates the personal equations of the operator in altering the advance.

As explained above, the intensity of the spark produced by the magneto depends on the speed of the engine. When the engine is running slowly, the intensity of the spark is less, and the charge is ignited slower, and thus the full force of the explosion is not accomplished until the piston about begins its power stroke. At high speeds, the intensity of the spark is greater, and, consequently, the ignition faster, so that again the explosive force is produced just about the period when the piston begins its power stroke.

Angle of Advance.

The best advance at which to set the magneto must depend on the style of engine and should be determined by trial. It must not be so great as to cause a "kick back" when cranking by hand or to knock when running at low speeds; yet it should be as great as the engine will stand without causing any of these faults. Ordinarily, the angle of advance will be from 5 degrees to 15 degrees ahead of the crank, depending on size and style of engine.

Spark Plug.

The mica spark plug is by far the most satisfactory, and should be used in preference to porcelain plugs. Porcelain plugs are liable to crack with the heat, thus causing the packing to loosen and likewise alter the gap between the electrodes. The mica plug has none of these objections, and will run for years with only occasionally adjusting the gap between the electrodes.

Engine Operation Supervision.

The greatest cause of unreliability which the gas engine of to-day may have is due to the want of proper care in operation. It is astonishing to see the great lack of knowledge and efficiency displayed by many who run and take care of these engines, therefore it may be well to enumerate a few of the most important rules and suggestions to be followed, and if these are regularly attended to in the operation of a well-designed and constructed engine, one may be confident that a most satisfactory and enduring machine will be found in this form of motor.

If the engine is constantly running, a careful inspection should be made daily of all nuts, bolts and springs, and compression noted when cranking. All bearings should be oiled and grease cups given half a turn. Spark plugs should be inspected about once each month, cleaned if necessary, and the distance between the points of the electrodes adjusted to about .5 millimeters. This distance depends on style of motor and compression, so that a fixed rule for all cannot be given. All electrical connections should be kept tight and free from dirt and oil.

The magneto should be oiled with two or three drops of best sewing-machine oil once each week, but great care must be taken not to allow oil to get on the contact breaker or the points. This part of the magneto should be inspected each week when oiling up the instrument. The contact breaker should be carefully wiped with a clean, soft, thin cloth to make sure that it is clean and free from oil. A narrow strip of clean writing paper drawn between the points when they are pressed together will show if there is any oil on them. If oil or dirt get on the contact-breaker points, the surfaces will not only become scored or uneven from being burned, but even firing will result. When this happens, the points will have to be very carefully dressed up with a fine, thin file. However, if the points are kept perfectly clean this will not be necessary.

REFRIGERATION DEPARTMENT

INSULATION THICKNESS IN REFRIGERATION PLANTS.*

AFTER the adaptability of a certain insulating material for refrigerating plants has been proved from all possible aspects, the next question is the determination of its necessary or proper thickness. As is generally known, the material employed for the insulation of cooling plants is expected to meet exceedingly exacting requirements, both in regard to absolute freedom from odor and unchangeability, as well as to durability and efficiency.

By rational thickness, we understand that thickness of the material by which, in regard to cost of application as well as efficiency, the greatest economy is obtained. The proper selection of insulation thickness, in accordance with these requirements, is not possible according to any set rule, because the factors entering into the calculation are variable. The heat-conductivity value, as well as the actual cost of the different materials, enter into the calculation as variables. Another variation is due to the differences in the construction material employed (brick, sandstone, concrete, wood, etc.), and finally operation expenses, differing according to the place of erection, must be taken into consideration, in connection with which the magnitude of the plant, and its caloric capacity must be considered. Consequently, as a rule, in determining the rational thickness of insulation, a comprehensive examination is called for. Following is shown in the simplest possible manner how in certain cases the calculation may be effected.

Starting Point For Calculations.

The starting point for calculations of this nature is formed by the researches of Peclet, and by making the necessary deductions for our own purpose, from the relation, established by him, between thickness of material, coefficient of heat conductivity, and heat transference, viz.:

$$(1)\ \ldots\ W = \frac{I}{\frac{S}{K} + \frac{s}{k} + \frac{o}{x} \ldots}$$

we arrive at the following formula:—

$$(2)\ \ldots\ s\ \frac{k}{W} - \frac{k}{k}\,S - \frac{k}{k}\,o - \ldots$$

in which

s=Thickness of insulation in meters.

S=Thickness of building material in meters.

k=Heat conducting value of the insulating material.

K=Heat conductivity value of the building material.

W=The rational heat transfer determined for the special conditions.

In cases where several construction strata come under consideration simultaneously, the final member of the equation must be determined separately. For (s), that is the thickness of walls, as a rule, only certain thicknesses come under consideration, which are dependent on the local customs.

The heat conductivity (k) of the insulating material is always quoted under guarantee by the respective manufacturer, so that the insertion of this figure in the calculation presents no difficulties. It must be noted, however, that where we are not dealing with a formal guarantee, very fantastic figures are often given as co-efficient of heat conductivity. As a rule, the average co-efficient of heat transference of the various materials used for the insulation of refrigerating plants, ranges between .04 and 0.1.

Heat Conductivity Feature.

The figures for the heat conductivity K of the building material employed for construction have been determined by competent parties in an absolutely reliable manner, but the most varying opinions are encountered in regard to the admissible heat transference W for the total structure, consequently including insulation. From researches conducted and in order to furnish a basis for general determinations they have recommended as a reasonable co-efficient of heat transference, 0.3.

For plants of moderate size and normal structural conditions with medium cost of operation, this may be fairly acceptable, but it is easy to perceive that a small plant must be equipped with thicker insulation than a large refrigerating plant, for on the one hand the operating expenses for small plants are so considerable as to make the best insulation desirable, and on the other hand, the cost of the insulation, owing to the comparatively small dimensions, is not of predominant importance. In very large plants, however, in which the cost of operation, per calorie produced, makes a more favorable showing, while the sinking fund and interest charges on the capital invested in insulation play an important part, a lagging of smaller thickness seems not only permissible, but from an economic standpoint, necessary.

If we use as a standard for certain conditions formula (2) which can be done, for example, with high-grade insulating material, by insertion of the corresponding co-efficients of heat conductivity, with due regard to the usual types (brick-masonry work), we arrive at a comparatively simple method of calculating the required thickness of insulation where there is only the permissible, under varying conditions, maximum heat transmission for the entire construction to be considered.

$$(3)\ \ldots\ s = t\ (r.\ 0{,}00186 - 0{,}00278\ S)$$

In this case, (r) denotes a co-efficient that expresses at once the relation of cost of producing cold to the normal market price of the insulation per unit. The highest temperature in the shade occurring at the place where the plant stands is denoted by (t).

The careful researches undertaken for the determination of (r) have yielded results applicable to all cases so that calculations made with it are made possible, with sufficient accuracy, for the determination of the thickness of insulation required for certain forms of construction. Of course, it still pays, in erecting a plant, to conduct the necessary exact special investigations, because anyhow, to prove that the plant will pay, all the data possible must be at hand. The value of the methods of calculation here shown lies mainly in the fact that they enable us to ascertain, approximately, what thickness to select in ordering a plant.

* * *

Guelph, Ont.—Jan. 1, 1915, the new power and light rates ordered by the Hydro-Electric Power Commission will go into effect. The new rates, as ordered by the Hydro-Electric Power Commission, make domestic lighting 3 cents per 100 square feet and 2½ cents per kilowatt hour, less 10 per cent. cash discount. The present rate is 4 cents per kilowatt hour, with 25 per cent. discount. The rates for commercial lighting will be 6 cents per hour for the first 30 hours' use, and 2½ cents per hour for all over that, with a discount of 10 per cent.

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*From a paper read before the Third International Congress of Refrigeration in Chicago.

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THE POWER SOURCE IN FACTORIES.

WHILE much attention has been bestowed upon and consideration given to the perfecting of machines and raising the efficiency standard of their operators in order to secure higher degree quality and increased quantity of product with, shall we say, a proportionate distribution of the fruits of achievement, no very conspicuous effort has been made, and that only spasmodic at best, to deal with the question of power at its source. To some extent, and more perhaps than we care to specify, this condition of affairs has been largely due to the more or less uninterrupted and lengthened period of business prosperity that preceded the present depression. Then, it was more than anything else, simply a matter of ensuring that that the motive power did not fail, and questions of economy and efficiency had to give place to operation reliability. The latter feature is of course not only highly desirable, but may be termed a necessity at all times. To secure reliability, however, need not be excuse to sacrifice economy, and to obtain the former at the expense of the latter shows either a lack of appreciation of what can be accomplished by the intelligent operation of the factory power plant or a persistency to believe—ample evidences otherwise notwithstanding, that **to keep going** matters most.

In spite of all this, however, and whether our attitude be either of those above stated or other equivalent, this matter of economy with efficiency, or shall we say economy with reliability will come home to roost, and in nine cases out of ten, to be moderate in our estimate, we succumb, and the steam power plant, which by its reliability gave us, not what its capabilities were, but the much underestimated proportion of these we chose as a safe margin for continuous operation, is relegated to the scrap heap. We succumb, as has been said, by purchasing power instead of generating it, as was our wont, and we reach that stage wholly as a result of the mistaken idea that steam power cannot be generated by us to hold its own both from the economy and reliability standpoints, against that purchasable.

It is not our aim at this writing to discuss the question of factory motive power with the idea of making comparisons, rather is it our purpose to draw attention to the fact, that the slowing-down of the wheels of industry should be taken advantage of to look closely and thoughtfully into the subject, familiarizing ourselves not only with what research and investigation have proved in the manipulation of steam power plants but with the aptitude of the men who operate them.

An expert salesman in any line of business seldom fails to win out, and in the selling of power for manufacturing purposes he has not usually a too formidable task ahead. That such should be the case is not justifiable, and is certainly only attributable to lack of appreciation of what can be done to put on a competitive basis one's own power generating plant. It has been estimated that nine out of every ten steam power plants in connection with factories in the Province of Ontario alone can be at one and the same time increased in economy and efficiency for the most part by simply **tuning-up** and by bringing the operation feature into conformity with present-day, high-degree performance practice. Want of economy in the factory power plant is by no means an incurable disease, even although its symptoms be fairly widespread in the different unit ramifications; neither are the remedies to be applied to bring the whole to the equivalent efficiency basis of the particular product of the factory such as to warrant wholesale scrapping and substitution.

In an early issue of The Power House we will start publication of a short series of articles dealing with this question of steam power plant economy and efficiency, and as the subject matter will largely consist of a recital of actual existent, uneconomical and inefficient conditions of operation, the steps taken to remedy these, and the success achieved, the information will be so interesting and valuable both to factory managements and their power staffs as to make effective appeal and bring about an improved set of conditions with respect to this important yet much neglected department of manufacturing enterprise.

The Operators' Point of View

COMMUTATOR AND OTHER TROUBLES.—I.

By. H. C. Thomas.

CONSIDERABLE experience in the operation of direct current generators and motors has taught the writer some of the troubles which this type of machine is heir to, and the following hints are offered as a means of overcoming them.

Without question the feature demanding most attention in this class of electrical machinery is that of the brush contact with the commutator. The nicety of adjustment of the brushes which is required in most cases, especially when working at or near full load, and the occasional attention which is needed as the brushes wear, are among the most important details. The introduction of the interpole type in which an intermediate pole is placed between each pair of main poles has reduced the tendency to sparking very considerably. There are, however, many machines in use without interpoles.

Sparking is an evil which must be stopped at all costs, for even though it be only slight, and taking place under the surface of the brushes, the latter will rapidly burn away, and the surface of the commutator become more or less roughened. The evil will gradually become worse, and the heating and sparking that ensue will, if not attended to, rapidly ruin the commutator surface. When the commutator is in good order it should present a dark (not black) burnished appearance, and this is impossible to obtain when sparking is taking place.

The Mica Insulation.

If the mica insulation of the commutator has not been chosen with sufficient care by the manufacturer, and proves in operation to be harder than the copper, the latter wears away the faster of the two, leaving the mica projecting above the commutator surface, a condition which effectually prevents good contact with the brushes and consequent sparking. Harder brushes will not always meet the case and the best way to deal with it short of rebuilding the commutator with softer mica is to remove the projecting mica periodically. This may be done with the armature placed stationary between the centres of a lathe, a miniature circular saw driven by a small motor being attached to the slide rest, and the saw worked up and down over the mica between the copper segments. The high mica may, however, be removed satisfactorily without taking the armature from its bearings by using a thin file on edge or a narrow scraper the same width as the mica. A guide of some kind will be necessary for the scraper and can be made in the following way:—

After the brushes have been lifted, take two wooden wedges of such a thickness that they can be jammed between the commutator and the brush holder with the fingers; fasten a strip of wood across the ends of the two wedges, so that altogether they form the three sides of a square; the strip will then lie parallel with the segments and act as a guide for the scraper or file when trimming down the mica. It is not advisable to go very deep; from 1-64 inch to 1-32 inch being usually sufficient. As each groove is completed, move the armature or rock the brushholder around to the next. This method will of course be a slow job with a large commutator and may be done a part at a time as the machine can be spared from the load.

Brush Spacing.

The exact spacing of the brushes around the commutator is, of course, one of the most important points to receive attention. The usual method of counting the number of segments between the brushes can be improved upon, particularly in multipolar machines, and when as is sometimes the case in the older machines, some segments are thicker than others, the results are not the best obtainable. A better method is to measure the distance between the brushes in the following manner:—

Place strips of strong white paper one or two inches wide under the brushes so that they bridge over the part of the commutator lying between each adjacent pair of brushes, the point where the brush touches the paper being marked with a sharp pointed pencil. Number the strips to show their positions on the commutator, then put them together and compare them, when the necessary alterations can be made to bring the brushes all the same distance apart.

For example, suppose we are working on a machine having four brush-holders, the true brush centres being 6¼ inches apart, measured along the arc of a commutator about 8 inches diameter. We will designate the brushholders top and bottom right, and top and bottom left, and the spacing top and bottom, right and left.

If, on measuring, we found the spacing as follows, top 6 inches, right 6¼ inches, bottom 6½ inches, left 6¼ inches, we would move the top right brush-holder, and bottom right brush-holder ¼ inch in a clockwise direction, and make them all equal; then try again with the paper strips and check results.

Bedding the Brushes.

When the spacing is correct, bed the brushes to the commutator by pulling a piece of sandpaper to and fro over the commutator surface with the rough side outwards, examining the brushes from time to time until they properly bed along their whole surface. The brushes should have freedom in the brush-holders, but no play; this point is of special importance when the armature has to run in either direction. If they are loose in the brush holders, they will change their position with each revolution of the sandpaper, making it necessary to hold the brushes in position while being bedded, or to draw the sandpaper in one direction only; say, by securing a band of it to the commutator and revolving the armature by hand.

When the bedding of the brushes is complete, clean off all carbon dust and start up, rocking the brushes into the best position for sparkless commutation. If you find this varies with the load, set the brushes at the best point for average load. Violent sparking which cannot be traced to any other cause may be due to one or more burnt out coils, which must be removed and replaced by new ones.

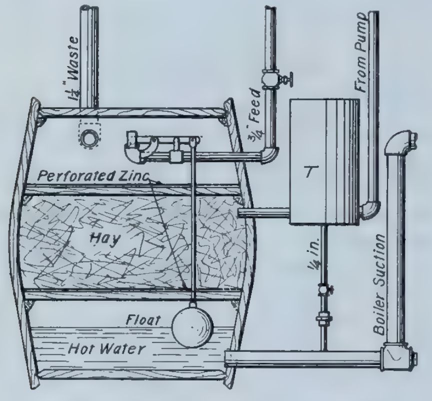
◆

A CHEAP FEED WATER HEATER.

By J. T. K.

RECENT descriptions in the technical press of great savings in cost of operation of and increased efficiencies obtained in power plants have done much to stimulate others to get into the game so to speak. The interest evinced by power house men in these accounts has served to encourage the writer to tell briefly of some of his experiences in connection with the first plant in which he assumed full charge armed with a third-class Alberta certificate. There are few plants in which improvements cannot be made and often, after a good man has apparently gone as far as he can go, another will step in and, by adding his experience to that of his predecessor, obtain some marked economies.

The plant in question was not large, being the equipment of a moderate sized laundry. It consisted of a 75 horsepower locomotive type boiler, 25 horsepower engine, and 3½ x 2 x 2½ inch pump. The plant was found to be in an astonishingly bad condition and the writer was told that previous engineers had had serious difficulty in keeping up steam, and that shut downs with consequent loss were sometimes necessary and, truly, a man had his work cut out for him to keep steam up.



CHEAP FEED WATER HEATER.

The finances of the firm were at the time in bad condition and material was either very hard to get or unobtainable. It was necessary to use old pipe for all changes along with a few pipe fittings which the firm was persuaded to buy. Nothing much was accomplished the first two weeks but some boiler cleaning, as it took most of the time to keep the furnace supplied with coal and much other extra work had to be done. A barrel which stood beside the boiler to receive town water to supply the injector was thrown out and the injector connected directly to the town supply. City water was also piped directly to the boiler for the purpose of filling it after cleaning. This had been very tediously done through the hand hole.

The boiler was found to be scaled to a thickness of over ¼ inch, probably due to the difficulties connected with cleaning. There was too much to do all at once, it had, therefore, to be done in stages. The writer was much surprised when, at the end of two weeks, the manager declared that a saving of $10 in coal had already been effected. This made the securing of extra equipment easier. The plant was arranged every way but the right way. The Marsh pump suction was connected up with ¾ pipe instead of 1¼ inch as it called for; the discharge was supplied with a ½ inch pipe in place of the required ¾ inch and, to complete as it were the settings there were a number of long and useless pipe connections about the place. These were made right and a barrel on the other side of the boiler which received water from an overhead tank to supply the pump was also thrown out, the pump being temporarily connected to the tank above.

For the feed water, the heater shown in the illustration was made during spare time. The main element of this is an empty oil barrel fitted with movable top and screens as shown. The perforated zinc sheets were made in halves and were supported upon wood frames shaped like the letter X. The compound feeder was made of an old gasoline tank and the water supply, governed by the float, came from the overhead tank. The rest of the outfit explains itself.

The feed pump was located on an enlarged window sill and, as there was no pipe to connect it up elsewhere; it had to remain there. The heater was placed on the floor beside it. This gave three feet of a lift and there was considerable doubt as to its working, but it turned out to be quite satisfactory. The feed pipe was always so hot that one could not bear the hand on it for more than a second, but as no thermometer was available, this temperature could not be measured. It was often necessary to stop the pump as it would not operate slowly enough to run continuously.

The removal of the pump exhaust from the stack and cleaning the boiler greatly improved the draught so that no steam was required to blow into the stack. Much of it had previously been necessary to assist the draught. The coal consumption was, at the end of four months, reduced to five tons per week in the coldest weather, but not without much disagreeable work. The boiler often had to be cleaned when the water froze around the hand holes, but then again these discomforts had their compensations. There was less coal to handle; the plant contained a satisfied and comfortable staff of workpeople, and the manager was a man who was not slow to show his appreciation.

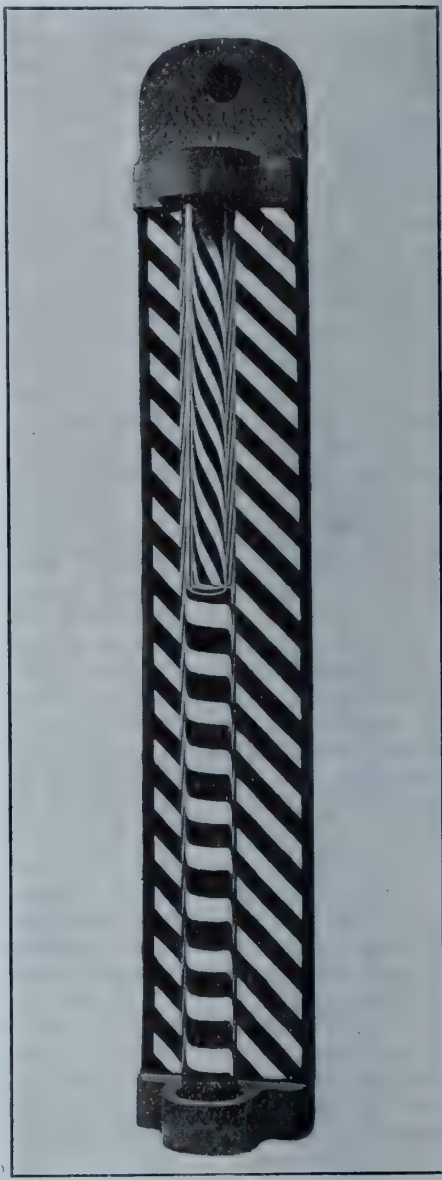
* * *

London, Ont.—The City Council are considering the question of purchasing water turbines, pumps and electric motors. H. J. Glaubitz is manager of waterworks department.

USEFUL ADJUNCT TO THE WATER COLUMN.

By. C. Cawsey Smith.

IT has often been the case that an effort along the lines laid down by the **safety first** movement has not only accomplished its aim as such, but has been a decided help to the progress of the work involved. An example of this is seen in the accompanying cut which is intended to illustrate a safety first setting for the water glass. The water gauge on some boilers such as a great many water tube types must be located some distance above the fireman on the upper drums of the boiler. These glasses, in the ordinary setting require some agility and a good pair of eyes on the part of the firemen in order to get a reliable view of the water level, particularly if there are several different water marks in the tube besides the actual top of the water.



USEFUL ADJUNCT TO WATER COLUMN.

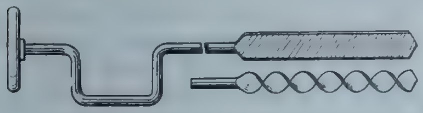
In the tube shown there is no doubt as to the true water level, and it can be seen from a long distance away, even under adverse circumstances. It is simply a tube half filled with water and plugged at both ends. The backing is a piece of strong paper painted alternately with black and white diagonal stripes, and the whole is mounted in a wooden frame for exhibition. A backing for practical purposes, of course, would have to be made of more substantial material but the white should be very white and the black stripes as black as possible and such as would stand frequent cleaning.

The slope of the stripes in the illustration could be steeper with advantage. This would cause the stripes in the glass above the water line to be more vertical and the level of those in the bottom part of the glass can be adjusted by varying the distance of the backing from the glass. The effect is not, as some would say, an optical illusion but is the result of refraction by two surfaces in the bottom part of the glass and four in the top part. Very much of the benefit to be derived from such a fixture depends upon the lighting of it. With a reasonable amount of care in making the back, and in adjusting it, results at least as good as those in the photo should be attained without difficulty.

QUICKLY MADE BORING TOOL.

By E. S. H.

THE boring tool shown in the accompanying sketch will be found very useful for cleaning out old holes or tubes or for removing scale and other accumulation in boiler gauge and water glass mountings. Take a piece of steel wire of convenient size and bend part of it in the form of a crank. Flatten out the other end evenly for a length greater than the depths of the holes to be cleaned. Heat evenly and, by holding the point with pliers and making use of the crank, twist in the backward or unscrewing direction, and grind the point similar to an ordinary drill. Fix a disc or small wheel on the other end and you have a little tool made in a few minutes that will replace many pointed wires, and will do a job of such quality and with such ease that the artifice will pay for itself in the first attempt.



QUICKLY MADE BORING TOOL.

The Waterous Engine Works Co., Brantford, Ont., have been awarded the contract by the Winnipeg Board of Control for supply of a boiler at $1,510.

AN UNUSUAL POWER PLANT REPAIR.

By Frank Rose.

GORGONA, once an important Canal Zone town, situated about half-way across the Isthmus of Panama, on the old line of the Panama Railroad, surrounded by mountains, and near the entrance to the Great Culebra Cut, and having a working population of about 2,000, including white men and black men, is now buried beneath the waters of the Great Gatun Lake. At Gorgona, the largest repair shops of the Isthmian Canal Commission and the Panama Railroad Co. were located, as also was the plant which generated the power and light for the shops and the town. For this purpose, there were two tandem compound engines fitted with slide valves.

Steam Chest Cover Smashed.

When the rainy season of 1910 had reached its maximum period, near the end of the year, much trouble had been experienced with muddy feed water and the boilers foaming on the least provocation. One rainy night some of this water found its way into the cylinders of the engines, with the inevitable result. The engineer, who was away from his engines at the moment, at the first noise of "pound," rushed to the cylinder cocks and opened them, immediately thereafter closing the throttle; but almost at the same instant, with a report like a cannon, the high pressure steam-chest cover of engine No. 1 blew off, and with it the lights went out, leaving us in total darkness.

Torches were at once procured from the round house, and as no one was found to be injured, we at once proceeded to look for the damage done to the engine, and found plenty. The slide valve was found to be broken beyond any possibility of repair, and the valve stem sprung, as was also the piston rod. As the night crew could not run their machines without power and light, all hands were put to work clearing up the wreck, and completely stripped both engines while still hot. Engine No. 2 was found to be practically uninjured, and after all parts were thoroughly cleansed and the cylinders neatly oiled, she was reassembled in short order.

When the lights went out in the town, the superintendent and the other day foremen immediately made their way to the shop to know the cause, and at once issued orders which would put things in running shape for the day crew as quickly as possible. While the men worked on the two engines, the electricians were busy cutting out the town systems and rewiring where necessary for the shop alone.

In one corner of the engine room, was an old air-compressor, which had long been out of use, but as there was a large fly-wheel to the machine, part of the crew was detailed to belt this machine up to the main shaft for one side of the shop, and the pipers soon had a connection with live steam. The machine tried out O.K., but was somewhat slow compared with our regular shop speed.

When the excitement was over, and work had been resumed on all available machines, many found small burns on hands, faces and arms from too close contact while handling the hot parts, and everyone became hungry on remembering that the usual night lunch had been missed. As quickly as possible, therefore, hot coffee was served with crackers, bread and jam.

The usual quitting time was 2 a.m., but owing to the accident in order to keep the work moving properly, overtime was ordered, and it was nearly 5 a.m. when we reached our quarters.

KEYS AND KEYSEATING.

By Armley Leeds.

IT is regrettable that so many plants take upon themselves the responsibility of adopting key standards to suit their own local convenience and with no regard to standards adopted by the more authoritative and better informed bodies. While an adherence to standards is to be very strongly recommended, a study of the disadvantages of different types will not be amiss. The tendency is almost entirely towards the adoption of a rectangular key which is sunk in both shaft and hub except for special purposes. The thickness and depths in shaft and hub, however, are the points which are most at variance.

In defining the size of the key, two methods are adopted, as shown in Figs. 1 and 2. Whichever is used, the sizes given always represent the head or larger end of a tapered key. The amount of taper allowed is 1/8 in. vertically in every 12 in. horizontally.

Another method of keying is that known as staking. Four or more keys are fitted upon flats on the shaft, and all the driving work is done by pressure upon the wide surfaces of the keys; that is to say, when driving the wheel in a certain direction the keys are under driving pressure where indicated by short lines in Fig. 3. The important feature of this arrangement is that the driving pressure acts directly upon the inclined surface of the key, not along the straight sides and therefore, in tightening a key, the actual driving surfaces are brought into closer contact, and any slackness is eliminated. Keys of this description are better adapted for withstanding reversible loads than the ordinary sunk key, and they also provide a means of turning the wheel on the shaft.

The ordinary sunk key, Fig. 4, combines the properties of the flat key, Fig. 3, with those of a bar of metal in shear. Taking these two qualities separately, the key is relatively narrow (viewed as a flat key) and, since there are usually only one or two sunk keys, the pressure on the broad surface as indicated by short straight lines is severe.

Regarded as a bar subjected to a shearing stress (presumably along the curved dotted lines), there is an objection that slackness resulting from driving pressure such as might be manifested at points C and B, Fig. 4, cannot be compensated for, because the sides of the key are parallel. This key combines some useful qualities, as follows: In cases where the drive is steady and not subject to sudden reversal or continuous alternations, the sunk key acts as a positive driving device in shear, and the broader or wedge-shaped surface fulfills the important duty of enabling the key to be wedged tight, so that its driving surfaces C^1 and B^1 are always closely applied to the driving sides of keyway in the shaft and wheel. The sunk key is useful for factory drives where the load acts continuously in one direction, but some other device is better where the drive is of an alternating character.

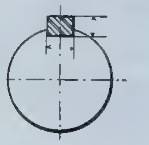


Fig. 1

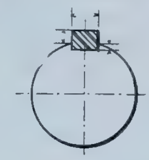


Fig. 2

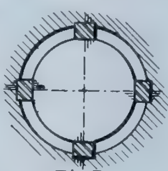


Fig. 3

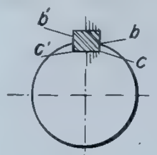


Fig. 4

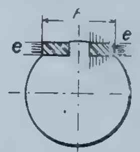


Fig. 5

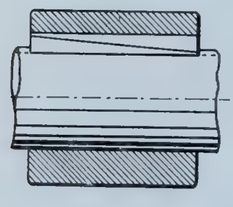


Fig. 6

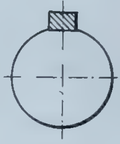


Fig. 7

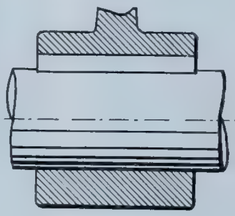


Fig. 8

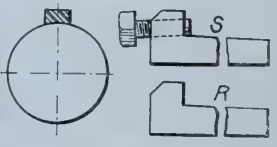


Fig. 9

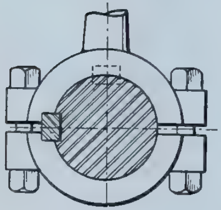


Fig. 10

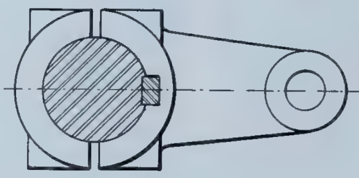


Fig. 11

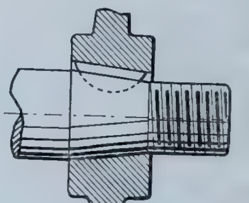


Fig. 12

KEYS AND KEYSEATING.

Where keys are subjected to stresses alternating in direction, a good type is shown in Fig. 5. The two opposed keys are tapered along their edges E and E^1. Their surfaces A and A^1 being flat, such keys may be said to combine the qualities of a flat key of width equal to the entire depth of the key. The sum of these properties offers a very lasting and substantial arrangement. With the driving shaft as shown in Fig 5, the driving pressure is divided between the two keys as indicated by the hatched lines, and vice versa when direction of rotation is changed. The pressure surface (e) is about equal in area to the equivalent driving sides of two ordinary sunk keys as shown in Fig. 4, and there is the advantage that, since the surface (e) is the inclined surface, slackness can be taken up as it arises. The driving surface afforded by the other key serves to tighten the load at (e). Keys of this description are locked tight against their driving seating, regardless of the direction in which the load is applied.

Folding keys, Fig. 6, are useful in cases where the key bed in the shaft cannot be allowed to extend beyond the hub of the wheel. One key is placed in its key seat in the shaft, the wedging being done with the other, which can be driven in or drifted out without coming in contact with the shaft. The keyway in the wheel is usually parallel, not inclined.

Flat keys, Fig. 7, are frequently used in place of sunk keys for light, steady running drives. The shaft is weakened less than is the case with sunk keys. For very light drives a key as shown, Fig. 8, is useful, especially where machine pulleys are likely to be moved from one place to another on the shafting when alterations are made.

Parallel keys are often adopted in electrical work. A typical case being shown in Fig. 9; set screws perform the function of tightening the key in lieu of the wedge formation. Any key may be formed with gib heads as at R or S which serves the purpose of withdrawal, where the point of the key is inaccessible, but this not not generally recommended.

Whilst single keys for hubs constructed in two halves are usually situated at the joint in deference to accepted practice, it may be shown that the correct position is at right angles to the joint, as shown in dotted lines in Fig. 10. In this position, although the stress on the bolts is increased, the stress is evenly distributed over the bolts, which are made larger than would be the case if the keying stress could be neglected. As upholding this opinion, a lever, if keyed by a single key, as in Fig. 11, would necessarily have the key at right angles to the joint. This principle should hold good and be equally applicable to a wheel which is simply a continuous lever. When it is necessary to put a nut on the end of a shaft or spindle, the "Woodruff System of Keying" is a most suitable form. In the works of which the writer has charge, we have a number of spindles with taper ends and threads for nuts as shown in Fig. 12 to make, and since the introduction of the Woodruff system our keying bill has gone down considerably.

RAWHIDE PINIONS.

By Chester Hamilton, Junr.*

RAWHIDE pinions are used in a great variety of drives where noise would be objectionable. Their commonest application is on electric motors, but they are also used on a wide range of other machinery. They will operate at much higher pitch-line velocities than all-metal gears.

The use of noiseless gear drives is increasing very rapidly. Formerly it seemed to be taken for granted that gears were essentially noisy and the only way to avoid the noise was to avoid the use of gears. This is all changed now. There are three principal ways of securing quietness aside from accuracy of workmanship:

First, by the selection of a fine pitch and providing sufficient strength by the use of high-grade material, such as heat treated alloy steel. Automobile gears are typical of this class, though in their case the very accurate gear cutting is also largely responsible for the quietness.

Second, by the use of helical or double helical gears in which there is a continuous rolling action.

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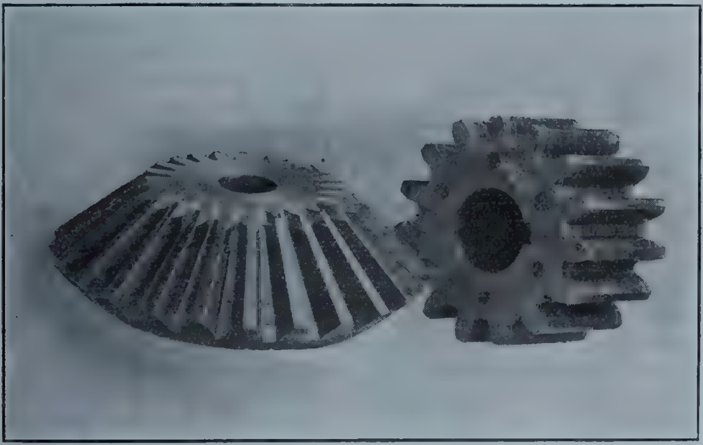
*Manager, the Hamilton Gear & Machine Co., Toronto.

Third, rawhide pinions, along with which are grouped those made of cotton, paper or compressed fibre. The quietness of this class is due to two reasons—the material, on account of its softness, does not transmit vibration or sound, but absorbs it, and the elasticity and slightly yielding nature of the material does not permit it to take up the load suddenly when it comes in contact with the mating tooth. The result is more evident in such a case as a rawhide pinion put to work with a worn-out gear with badly shaped teeth. The sound is in the nature of a throb where it would be a ringing blow if both were metal. When the tooth shape is correct, the rawhide pinion makes practically no noise at all.

First-class materials are essential for durability and strength. There are a number of grades of hide on the market, and some are not very good. Some first-class brands are much over-rated and over-valued by their makers and are accordingly not worth the price asked. The flanges of a rawhide pinion should be of red brass; there being little saved in using poor yellow brass. Steel would be all right, but the cost of machining, including cutting, runs up out of proportion to the value. Cast iron or steel are frequently used on very large pinions, but very seldom on small. The rivets should be of soft Norway or Swedish iron, and be a driving fit in the hole.



RAWHIDE PINIONS.

Rawhide pinions should be kept dry and free from oil. Most oils and even atmospheric dampness shorten the life of a pinion and reduce its strength. The pinion should be protected and at the same time lubricated with a thick paste made from linseed oil and flake graphite.

Pinions should be designed with flanges of full outside diameter. The omission of flanges or the use of flanges less than the outside diameter is not at all advisable. Such designs are not durable. Shrouds, that is plain flanges put on after the teeth are cut, are of no advantage, are expensive and sometimes cause trouble by interfering with the gear teeth, if gear or pinion becomes shifted sideways. Sometimes a third flange is placed in the middle of the pinion dividing the rawhide into two parts. The object is to increase the strength on heavy drives, but it is of doubtful value, and certainly makes a noisier pinion than plain rawhides. For quiet running, the flanges should never touch the gear, the face of the pinion being increased to twice the flange thickness greater than the face of the gear. If the pinion shaft is free to move endways a short distance, as on a motor, the face of the rawhide between the flanges should be increased by the amount of the travel. It is common to add ⅛ inch to these dimensions so that the flange always clears the gear by 1/16 inch. Pinions of very wide face sometimes have bolts instead of rivets. If the diameter of the pinion is large and the flanges relatively thin, an additional circle of rivets near the bore is occasionally used. In designing small diameter pinions with large bores, care must be taken that there is ample material between the root of the teeth and the rivets.

A rawhide or other built-up pinion should be driven with a key rather than a set screw. The latter applies the power directly to one flange only and causes a twisting of the pinion which tends to tear it apart. Rawhide pinions are generally figured as equal in strength to their cast iron mate; that is, they are a little better than a cast iron pinion. Good fibre is about half as strong.

* * *

CORLISS VALVE SETTING QUERY.

TO set Corliss valves: — First set the rock-shaft or rocker arm and wrist plate plumb (by line and plumb bob). Take off valve chest covers and place both steam and exhaust valves so that ports are closed and valves have proper lap. This can be done by right and left hand adjustments in the rods connecting the wrist plate with the valve stems.

While valves are in this position see that dash pots or plungers are down and properly seated. Adjust the length of the eccentric rod as for plain D valve. Next, place the crank on the head dead centre and turn eccentric centre to the same position. If engine is run **over,** the valve at head end should be released by hand and closed. Turn eccentric around on shaft until the valve is again engaged and opens the port to the amount of the lead. Fasten eccentric to shaft; turn engine to opposite dead centre and note the amount of the lead, dividing the difference, if any, equally at both ends by means of the right and left hand adjustments of the rods operating the valves. Now block up the governor to about its normal position while running, and have engine turned slowly. Note the point in both forward and return strokes at which the valves are released or **drop.** If this does not take place at exactly the same point in both strokes, adjust rods running from governor to trip cams until valves drop properly.

Exhaust Valves.

After determining the amount of compression to be given, for example say 3 inches, turn the engine in the direction it is to run until the crosshead stands 3 inches from the end of its stroke. By means of right and left hand adjustments, set exhaust valve at end of cylinder so that it just closes the port. Turn engine over to the opposite end of stroke and adjust the other exhaust valve in the same way. Release governor and put on valve chest covers.

* * *

VALVE SETTING—THE PLAIN D SLIDE VALVE.

By H. W. Benton.

THE plain D type of engine slide valve and the method of properly adjusting it are supposed to be so well known that it would seem superfluous to spend time in explanation. However, it appears to me that if this simple, old-fashioned valve were more thoroughly understood by some men, they would more easily master other types of valve and valve gear, become more satisfied with themselves and incidentally of more value to their employers. The trouble is that too many mistake an idea for a reality. I will illustrate this with a case from my own experience.

I was called to a shop, building cranes and bridge work. A considerable quantity of compressed air was used, this being produced from a straight-line Ingersoll Compressor, the high-pressure cylinder of which was fitted with D slide valve. The compressor and boiler were in charge of the master mechanic, who acted both as master mechanic and engineer, while the firing was done by a handy-man. The master mechanic-engineer had a certificate and was therefore **duly qualified and so forth to be entrusted with the duties of a stationary engineer.** In any case he could hand out a line of goods that would lead one to believe that he knew "how" allright.

Before I got very close to the plant I could hear the exhaust of the compressor snorting. The master mechanic-engineer argued that the air cylinder required the most power for the last half of the stroke, and that the steam cylinder valve had to be set to meet this requirement. Therefore, he had rolled the eccentric back on the shaft so as to get the valve to cut off at $\frac{7}{8}$ of the piston stroke; hence the valve opened to admit steam to the cylinder at $\frac{3}{8}$ of the piston stroke. He argued that no power was required for the first part of the stroke and that, once the machine was running, the flywheel would supply this small amount of power. Again by setting the valve late, steam was supplied to the engine cylinder at the point where the air cylinder was hardest to drive. To a new man or a student this argument might be accepted, but not by any one who thoroughly understands the proposition. He had an idea and thought he was clever and knew it all, but he had no knowledge. His work and argument proved he knew very little.

While the compressor had been operated with the valve set as stated above, the machine had been very sluggish, for if the boiler pressure was allowed to drop 15 lbs. they could not keep the air pressure up the required amount because the compressor ran slow, and alteration of the governor did not affect the machine speed as it should. It only required a short time to properly adjust the valve, and the improvement in the behavior of the compressor was proof of the fact that the master mechanic-engineer was wrong in his idea of valve-setting. The handy-man said his boiler steamed easier. This little incident from actual experience proves that many who "know" simply think so.

The First Step.

The first step in setting a plain slide valve is to adjust the valve to travel equal distances each side of its centre position. This can be done in two different ways:

(1) If the engine be small enough to be easily turned by hand, then place crank on exact dead centre, and note the position of the valve—that is how much lead there is (the amount the steam port is open when the crank is on the exact dead centre.) Next turn engine onto the other dead centre and note lead at other end of cylinder. If the leads are not equal, lengthen or shorten the valve stem as required, so as to make them so. If the leads be excessive after equalizing, then the eccentric must be shifted back so as to reduce them to the desired amount. All inequality of valve travel must be adjusted by lengthening or shortening the valve stem. Too much lead indicates that the valve opens the ports too early, thus the complete cycle of events occur correspondingly early.

The other method of adjusting a plain slide valve applies to engines that are too large to be easily turned by hand. In this case, loosen the eccentric so that it can be turned around the shaft, and with the steam chest cover removed, turn the eccentric around on the shaft, noting the maximum port opening (never mind where the crank is placed, forget that there is anything else but the valve, valve ports and eccentric). Adjust the length of valve stem, if necessary, so that the steam ports are opened the same amount for each end of cylinders. This equalizes the valve travel. We have now only the eccentric to set.

Place the crank on exact dead center and turn the eccentric around the shaft in the direction the engine is to run until the valve opens the port at the proper end of the cylinder a sufficient amount of lead. Secure the eccentric in this position. Be careful to turn the eccentric around the shaft in the same direction that the engine is to run and secure it at the point where the steam port is opening, for if the eccentric is secured at the point where the steam port is closing the engine will run in the opposite direction.

Those then are the only two points to be noted in the setting of a plain slide valve—the valve must be adjusted to travel equal distances each side of its central position so as to give equal port opening, and the eccentric must be placed so as to give proper lead. By making these adjustments, the distribution of steam to and from the cylinder will take place properly according to the design of the valve and ports.

Valve Working Edges.

There are four working edges on a plain slide valve. Two are for the control of steam inlet and two for the control of exhaust outlet. Each steam inlet edge opens the port for the inlet of steam to the cylinder, and closes the port or cuts-off the supply of steam to the clylinder so that its expansive power drives the piston for the remainder of the stroke. Each exhaust edge opens the port to allow the expanded steam to escape to the atmosphere or condense, and closes the port just before the piston reaches the end of the return or exhaust stroke so as to trap a small amount of steam in the end of the cylinder, to be compressed and to form a cushion, by the piston in completing its stroke; thus helping to stop the reciprocating parts and reverse any lost motion before the live steam is again admitted.

The Corliss Valve.

We have now come to see the plain slide valve as a four in one unit. Four edges each performing a separate and distinct duty. The steam inlet edges open and close the inlet port. The exhause edges open and close the exhaust port. Let us now separate these four edges and call each a valve. We will place each steam inlet edge in the upper corner of the cylinder casting and each exhaust edge in each lower corner of the cylinder casting. By doing so we got the Corliss engine valve feature—four separate valves, two steam valves two exhaust valves. Each steam valve opens and closes the exhaust port. In the simple Corliss engine, all four valves are connected to and operated by one eccentric just the same as a plain slide valve, and these four valves perform the same duties as the one plain slide valve. Only one difference exists. With the plain slide valve the speed of the engine is controlled by throttling the steam supply to the cylinder. Thus the pressure acting against the piston varies according to the load on the engine, as a result of the action of the governor opening or closing the governor valve with the varying load on the engine. All events of steam distribution are positive: that is they do not alter or change.

With the Corliss type valves three events are positive and one is variable. Admission, release, compression are positive while cut-off is variable. These engines are regulated or governed by varying the point of cut-off according to variations of load. Boiler pressure is admitted into the cylinder at the commencement of each stroke and the steam is cut-off by the closing of the steam valve, somewhere between the commencement and 45 per cent. of the piston stroke according to engine load. A properly adjusted Corliss engine will, if the load be suddenly thrown off due to the main belt breaking, not open the steam valves at all.

Setting Corliss valves will be taken up in our December issue.

◆

Simplex Specialties are described in a catalogue just to hand from the Bromell Patents Co., Ltd., Glasgow, Scotland. Among the "Simplex" patent specialties included in the catalogue are valve reseaters, tube scrapers and steel wire tube brushes, tube scaling machines, condenser tube scrapers and brushes, gauge glass cones and tube cutters, etc. The special features of each apparatus and their application are described, while the illustrations show in a clear manner the general design of each. It is stated that these specialties are used by many of the leading power plants.

Question and Answer Series

Question.—What power would be required to draw a load of 200,000 pounds up a grade 1,000 ft. long with a total rise of 50 ft. in one minute, friction being considered as 2 per cent. of the load?

Answer.—Power required to move load of 200,000 pounds against 2 per cent. friction $=\frac{2}{100}$ of 200,000.

As this moves through 1,000 ft., the power used is $\frac{2}{100}\times 200{,}000\times 1{,}000=$ 4,000,000 ft. pounds.

To raise 200,000 pounds 50 ft. requires $200{,}000\times 50=1{,}000{,}000$-foot pounds.

Total number of foot pounds $=4{,}000{,}000+1{,}000{,}000=5{,}000{,}000=\frac{5{,}000{,}000}{33{,}000}$

$=151.5$ h.p.

* * *

Question—Why is the vacuum line drawn below the atmospheric line a distance equal to 14.7, divided by the scale of the spring?

Answer.—Each inch in height measured on the diagram represents a pressure equal to the scale of the spring. Thus a diagram drawn with a 40-spring and 1½ ins. high represents $40\times 1\frac{1}{2}=60$ pounds per sq. in. at that point. It is obvious that to represent 14.7 pounds, the height would be equal to 14.7÷scale of spring. In the above case this would be $14.7\div 40=.3675$ in.

* * *

Question.—How is excessive back pressure shown on an indicator diagram?

Answer.—As stated in the previous example, any point on the diagram represents by its height the pressure in the cylinder at the instant marked by that point. It follows, then, that excessive back pressure will be shown by an extra high exhaust line. In non-condensing engines, this means a considerable space between the atmospheric line and the exhaust line above it, and in condensing engines, the distance from the atmospheric line down to the exhaust line of the diagram will grow less as the back pressure increases. The lower the bottom line of the diagram the less the back pressure.

* * *

Question.—In a simple non-condensing engine, cut-off occurs at five-eighths stroke. Cylinder diameter is 12 in., stroke 26 in., speed 100 r.p.m., and steam pressure 90 pounds gauge. Determine horse-power developed.

Answer—Horse-power formula is $\frac{plan}{33{,}000}$ where p=mean effective or average pressure in pounds per sq. in.; l=length of stroke in feet; a=area of piston in sq. in.; n=number of strokes per minute, and 33,000 is a constant for 1 horse-power.

In this case the m.e.p. will have to be found by a supplementary formula as follows:—

$$\text{M.e.p.}=\frac{.9P\ (1+2.3\ \log\ r)}{r}-.9p$$

in which P=absolute steam pressure
= gauge pressure+14.7 pounds.
r = ratio of expansion.
p=absolute back pressure.

P can be taken at about 3 pounds for condensing and 18 pounds per sq. in. for non-condensing engines. The ratio of expasion should be determined from the point of real cut-off, to determine which the clearance volume should be known. As this is not given, we will use the apparent cut-off given above. This gives a ratio of expansion of,

$$\frac{\text{volume of cylinder}}{\text{volume at point of cut-off}}=\frac{113.1\times 26}{113.1\times 16.25}$$

=1.6. The logarithm of this is, from the tables, .20412.

The value .9 is known as an indicator factor, and depends upon the quality of valve gear, etc., and the 2.3 serves to change Napierian to natural logarithms. The formula now becomes

$$\text{M.e.p.}=\frac{.9\times 90(1+2.3\times .20412)}{1.6}-.9\times 18$$

$$=\frac{81(1.469476)}{1.6}-16.2=74.33-16.2=$$

58.13 pounds per square inch.

Horse-power of engine, then, is

$$\frac{=58.13\times\frac{26}{12}\times 113.1\times(100\times 2)}{33{,}000}=$$

$$\frac{58.13\times 26\times 113.1\times 200}{33{,}000\times 12}=86.331\ \text{h.p.}$$

Question.—In a triple expansion engine, 28, 52 and 72×54, the mean effective pressures in the several cylinders are 60, 38 and 18 pounds absolute. Find i.h.p. at 100 r.p.m.

Answer.—This may be found either by adding the horse-power of the cylinders calculated separately or by reducing the h.p. and I.p. to corresponding pressure on the low pressure piston, and calculating horse-power upon low pressure cylinder only.

Areas of cylinders are 615.75, 2123.7 and 4071.5 sq. in. H.P. reduced to

$$\text{L.P}=\frac{60\times 615.75}{4071.5}=9.07$$

$$\text{I.P. reduced to L.P.}=\frac{38\times 2123.7}{4071.5}=19.824$$

Total equivalent pressure on low pressure cylinder$=18+19.824+9.07=46.894$ pounds per sq. in.

$$\text{Horse-power}=\frac{46.894\times 54\times 4071.5\times 200}{33{,}000\times 12}$$

$=5207.04$ horse-power.

Note.—Both the above and the former engine exhibit very poor design.

* * *

Question.—How would you increase the power derived from a throttle governor engine?

Answer.—There are two ways of doing this, namely, increase the speed and increase the mean effective pressure. As the governor is usually set to operate at its best working position, it is best not to change its speed from that for which it was designed. The better way is to increase the size of the pulley which drives it so that, while the engine would go faster, the governor would rotate at the same speed. To increase the power at the same speed, the throttle would have to open wider. This could be done without altering the working position of the governor by adjusting the throttle valve stem. The mean effective pressure can be increased slightly by decreasing the lead which will retard the point of cut-off.

* * *

Question.—How would you increase the power of an automatic cut-off engine?

Answer.—The same applies to this in principle as to the former case. The speed would be increased by tightening up the springs, decreasing the weights, or moving them closer to the centre of the wheel. In this type of engine, the governor will usually give as late a cut-off as is good for the engine or the plant and, beyond making a few adjustments to the governor, it is better not to make further alterations to the lap of the valve, etc.

* * *

Question.—What are some of the causes of knock in engines?

Answer.—There are many reasons to account for this, such as water in the cylinder, loose piston or piston nut, loose crosshead pins or nuts loose bearings, etc. End play of rod bearings, ridges worn in cylinders and slides, wrong adjustments of clearance, etc., are also fruitful causes of this trouble.

* * *

Question.—How would you proceed to set the slide valve of a simple engine?

Answer.—Two separate things are necessary:

(1)—Centralize the valve motion. That is, adjust the length of valve rods until the valve moves centrally about its seat—as much to one side of the ports as to the other.

(2)—Set eccentric to give correct angle of advance. This requires placing the engine on the dead centre which should be accurately done. If eccentric is keyed or otherwise permanently fastened, it is simply necessary to set the valve for equal leads or, in the case of a vertical engine, the lead is made a little greater at the bottom than at the top.

* * *

Question.—Describe the operation of the steam loop, separator and superheater.

Answer.—The steam loop is an appliance for returning the water of condensation from a steam pipe or separator to the boiler. It consists of vertical pipe or **riser** from the separator which empties at a considerable height into a pipe called the **horizontal.** This is connected to the boiler by another vertical pipe called the **drop leg.** It acts as follows:—The drop leg becomes filled with water, the weight of which above the boiler along with the slightly lower pressure of the separator just balances the boiler pressure. As steam condenses in the horizontal leg, the steam and water from the separator go to take its place, because these are lighter than the water in the drop leg. The result is that some of the water in the drop leg goes into the boiler. This goes on more or less continuously.

A steam separator is an apparatus for the purpose of removing grease, dirt and entrained water from a current of steam flowing through a pipe. The separation is accomplished by suddenly changing the direction of flow of the steam, giving it a spiral motion or directing it against deflectors. The latter principle is utilized more in separating oil dirt and other impurities.

A steam superheater is an apparatus for the purpose of heating the steam to a higher temperature than that corresponding to its pressure. The process consists in heating the steam in a coil or other form of heater after it has been taken from the boiler. The pressure is not changed, but the steam remains dry until the temperature falls below that of saturated steam of the same pressure.

* * *

Question.—An engine makes 120 turns per minute, and is to drive a dynamo at 1,200 r.p.m. through a counter-shaft which is to run at 450 r.p.m. Engine fly-wheel is 8 ft. and dynamo pulley is 10 inches in diameter. What must be the diameters of the driving and driven pulleys on the counter-shaft?

Answer.—Size of driven wheel on

$$\text{counter-shaft is } \sqrt{\frac{8\times12\times120}{450}} = 25.58$$

ins. dia., or, say, 25-inch pulley.

Size of driving pulley on counter-

$$\text{shaft} = \frac{10\times1200}{450} = 26.6, \text{ or, say, 27-}$$

inch pulley.

* * *

Question.—A slide valve is 10 inches long and 16 inches wide. If the steam pressure be 125 lbs. per sq. in., what should be the size of the valve stem?

Answer. — Area of valve $= 10\times16 = 160$ sq. in.

Force pressing the valve to its seat is $160\times125 = 20{,}000$ pounds. Taking the co-efficient of friction for unlubricated cast iron surfaces at .25, the force required to move the valve will be 20,000 $\times .25 = 5{,}000$ lbs.

Taking the ultimate strength of steel at 60,000 lbs., and using a factor of safety of 10, we get for the working

$$\text{strength } \frac{60{,}000}{10} = 6{,}000 \text{ lbs. per sq. in.}$$

With this factor of safety we may consider only the tensile strength of the rod.

$$\text{Area required} = \frac{5{,}000}{6{,}000} = .833 \text{ sq. in.}$$

$$\text{Diameter} = \sqrt{\frac{\text{area}}{.7854}} = \sqrt{\frac{.833}{.7854}} = \sqrt{1.0606}$$

$=1.029$ in. Use a 1-inch valve stem.

* * *

Question.—A coal bin feeding a mechanical stoker is rectangular in shape, with a bottom coming to a point like a pyramid. The walls are 6 ft. by 12 ft. by 5 ft. high, and the tapered part is 6 ft. deep. How many tons of pea coal will it contain?

Answer.—The volume of the rectangular part is $6\times12\times5 = 360$ cu. ft., and the volume of the pyramid shaped part is the area of the base multiplied by one-third the height.

$$\text{Volume then is } \frac{6\times12\times6}{3} = 96 \text{ cu. ft.}$$

Total volume of bin $= 360+96 = 456$ cu. ft. One ton of coal occupies 32.767 cu. ft.

$$\text{Number of tons in the bin is } \frac{456}{32.767}$$

$$= 13.917 \text{ tons.}$$

* * *

Question.—The crank arm of an engine is 13 inches long and the length of the connecting rod is 65 inches. If the engine be running under, and the pressure on the piston be 2¼ tons, what will be the greatest thrust of the crosshead against the upper guide?

Answer.—Size of driven wheel on ton in this case may be resolved into a vertical component and a horizontal component.

The vertical component is represented by 13 and the component in line with the connecting rod is 65. The horizontal component is $\sqrt{(65^2—13^2)} = 63.6$. This horizontal component actually is 2¼ tons, therefore the vertical component which acts against the guide is

$$4250 : 63.6 :: x : 13$$

$$X = \frac{4250\times13}{63.6} = 868{,}707 \text{ lbs.}$$

* * *

Question.—If a man raises a weight of 900 lbs. 150 feet in fifteen minutes, by means of a winch, how much work has he done, and what part of a horse-power would this be equivalent to?

Answer.—Foot pounds per minute

$$= \frac{150\times900}{15} = 9000 \text{ foot pounds of work.}$$

$$\text{No. of horse-power} = \frac{9000}{33000} = \frac{3}{11}$$

horse-power.

* * *

Question.—In the above problem, what horse-power was actually expended assuming friction to be 40 per cent. of the load?

Answer.—$\frac{40}{100}\times9000 = 3600$ foot lbs.

Total work done is, therefore $9000+3600 = 12{,}600$ foot pounds.

$$\text{This is } \frac{12{,}600}{33{,}000} = .3818, \text{ or } \frac{4.2}{11} \text{ horse-}$$

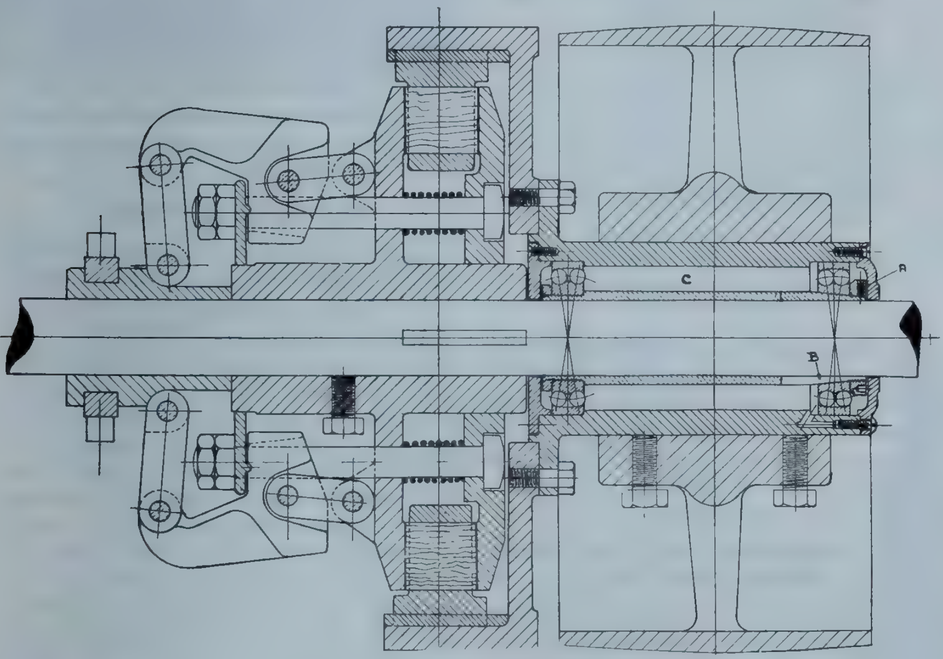
power.

Progress in New Equipment

BALL-BEARING CLUTCH.

THE drawing shows a universal friction clutch fitted with Skefko double-row, self-aligning ball bearings, recently placed on the market by the Canadian Fairbanks-Morse Co., Toronto, several being in service and giving, we understand, entire satisfaction. This clutch is thoroughly modern, and embodies many points of excellence in design and construction. It is of compact form, unusually strong, and is easily applied and readily adjusted. The clutch is complete within itself, and does not require specially constructed appliances to be fitted to it.

The extended hub fitted with ball bearings is locked to the shaft when in position by the one nut A, which causes the split taper sleeve B to grip the shaft with great pressure owing to the fine pitch thread and very slow taper on the sleeve. Any pulley, gear, rope sheave or sprocket may be fitted to the hub in the usual manner.



BALL-BEARING CLUTCH.

The use of ball bearings in a friction clutch has many advantages, the chief being that of durability and freedom from trouble due to heating of hub through the lubrication being thrown by centrifugal force away from the shaft surface. The chamber C need be filled with lubricant only once every six months.

The outer rim of the clutch covers and protects the friction surfaces from dust, dirt or other foreign substance, making the apparatus especially suitable in cement mills and elevators, or places where dust or gritty substances are afloat in the air. The friction surfaces, which have a large area, are wood and iron. Selected hardwood blocks are fitted into the friction disc so as to present two end grain surfaces, which come in contact with the two iron surfaces of the friction plates.

The mechanism for drawing the friction surfaces together is powerful, and can be easily adjusted to take up any wear that may occur. When thrown into or out of engagement, the friction disc and follower plates adjust themselves within the clutch, thereby eliminating end thrust.

* * *

Ottawa, Ont.—The Sprague Falls Manufacturing Co. has applied to the Public Works Department for leave to divert the St. Croix River in New Brunswick. The matter will be reported on and eventually go to the International Waterways Commission.

A SCALE-PROOF BOILER.

CANADIAN rights to manufacture a scale-proof boiler have been obtained by the Alex. McKay Boiler Works of 1194 De Montigny Street East, Montreal, P.Q. This product is a recent development, and is more easily applied to boilers of the internally fired fire-tube design. Extensive tests have, we understand, been carried out on a small vertical boiler, the results of same being of considerable interest. The general design of the boiler is as follows:—

General Design.

By referring to the accompanying cut the description can be more easily followed. The crown and top sheets of the boiler are constructed in the usual manner, as is also the outer shell. The scale-proof feature is a settling chamber, where all scale-forming material is precipitated. A flanged ring is attached to the inside of the boiler shell a little above the lower tube sheet. To this inner flanged ring a casing is riveted, which extends well above the normal water level. Thus, a water-tight annular chamber is formed inside the boiler shell. This annular chamber is, however, open at the top to the steam pressure in the higher portion of the boiler. Near the top of the casing, and well above the normal water level, are punched several holes.

When in operation, the feed water is fed into this annular chamber at a point opposite to the holes cut in the casing, and when the water in the annular chamber rises sufficiently high, it overflows into the boiler proper, and here comes in contact with the fire-swept heating surfaces. Over these holes is placed a hood, which extends below the level of the water in the annular chamber some fifteen inches. Any floating material, such as oil and other scale-forming substances, will not thus overflow into the boiler proper, as the water that passes through these holes is drawn from a level fifteen inches below the surface. At the bottom of the settling chamber is a blow-off valve, and placed at small intervals around the bottom of the settling chamber are several hand holes. These constitute the principle new features of the design. The fire-box is surrounded by the water which has passed through the annular settling chamber to the boiler proper, this construction necessitating the use of staybolts. In other details, the standard methods of boiler construction have been adhered to.

The Working Principle.

As the steam pressure is acting upon the water in the annular chamber, this water becomes very warm. In boilers delivering steam at 100 pounds' gauge pressure the water in the annular chamber often rises above 300° F. The effect of this is to precipitate all solid matter dissolved or in suspension.

Experiments have shown that the carbonates are nearly all precipitated at or about 200° F., and the sulphates at or about 280° F., and these two scale-forming nuisances comprise nearly all of the impurities in water which have any bad effects on boilers. They are precipitated to the bottom of the settling chamber, and stay there in a jelly-like mass of sludge until blown off. The reason why this sludge does not form scale is because it does not come in contact with any fire-swept or heating area, and the blow-off valve located at the bottom of the settling chamber, if opened once a day, will carry off all the sludge that accumulates.

The feed water is fed into the annular chamber on the opposite side of the casing to where the holes are located, through which the water flows in entering the boiler proper, and the hand holes around the bottom of the annular chamber provide a means whereby the bottom of the annular chamber is made easy of access. Hand holes are also provided in the lower portions of the boiler, giving access to these lower portions in the fire-swept heating surfaces. The water that passes over into the boiler is practically distilled water.

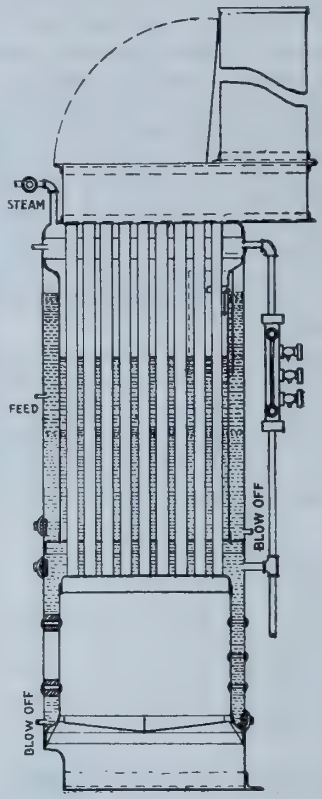
Recent Tests.

In a small vertical boiler of the type just described two very severe tests were made. Twenty pounds of dry earth, twenty pounds of lime, ten pounds of plaster of Paris, making a mixture with a quantity of water that strongly resembled milk, was fed into the boiler. After the whole mixture was fed in and evaporated, the boiler was shut down and the whole quantity of earth, lime, and plaster of Paris was recovered from the settling chamber.

The second test was even more thorough. The Montreal water by analysis contains 5 grains of scale-forming material per Imperial gallon. In the test, 600 Imperial gallons of water were evaporated. By calculation there should be four pounds and fifteen ounces of scale-forming material in this amount of water. During the test, the boiler was not blown off at all, and upon the total amount being evaporated the boiler was allowed to cool off. The sludge was collected in a pail and dried out. The dry weight was four pounds two ounces. A certain amount, of course, was not scraped out of the boiler, and naturally so much got on the clothes of the man who gathered up the sludge, thus the other thirteen ounces are quite easily accounted for.

Smoke Box and Stack.

An offset smoke stack is usually fitted on these boilers, together with a large well-designed smoke-box. The smoke-box is made so that it can be easily removed, thus, when the flues need cleaning, a man can get right at them. This equipment, although standard, is not by any means necessary to the proper operation of the boiler, but is simply a method of making the flues easier of access.



DESIGN OF SCALE-PROOF BOILER.

LOW PRESSURE AND EXHAUST STEAM HEATING.

TO operate a steam plant at the greatest efficiency, every available unit of energy must of course be extracted from the steam. Taking steam that is raised to one hundred pounds pressure in a boiler, we find that its temperature is about 337 degs. F., and in the average non-condensing engine it is rarely that the steam is expanded until it is down to a temperature of 220 degs. F. Thus, all the heat used in raising the steam from a normal temperature of say 60 degs F. (which is a rather high normal temperature), is lost.

To the lay mind this loss is great, but upon investigation it is discovered that the loss is much greater than it appears to be upon casual observation. The amount of heat required to raise one pound of water one deg. F., is defined as one calorie, and it also requires one calorie to raise one pound of steam one deg. F. For all practical purposes this law applies to water at all temperatures and to steam up to all temperatures usually met with in boiler practice. However, at 212 degs. F., the temperature at which water becomes steam under atmospheric pressure at sea level, a peculiar phenomenon occurs.

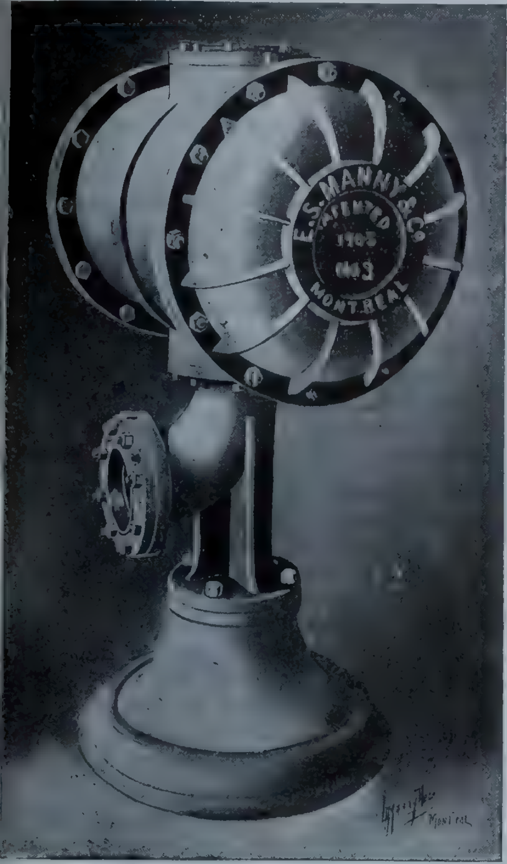
One pound of water at 212 degs. F., absorbs 535 calories without the temperature being raised. The water turns from a liquid into the vapor, steam, and it appears that a pound of water must absorb 535 calories of heat in accomplishing the physical change. In such cases we always find action and reaction are equal and opposite. The result is that, when steam is condensed, this heat is given off. Thus the waste of heat energy through the use of any atmospheric exhaust is much greater than would appear from a casual glance. There are two ways of utilizing a portion of this energy. The first is to use a condenser in connection with the engine and to feed the hot water of condensation back into the boiler again. The second way is to use the exhaust steam for the purpose of heating buildings.

Many successful systems of low pressure and exhaust steam heating have been devised, and thus many adaptations are in service to-day.

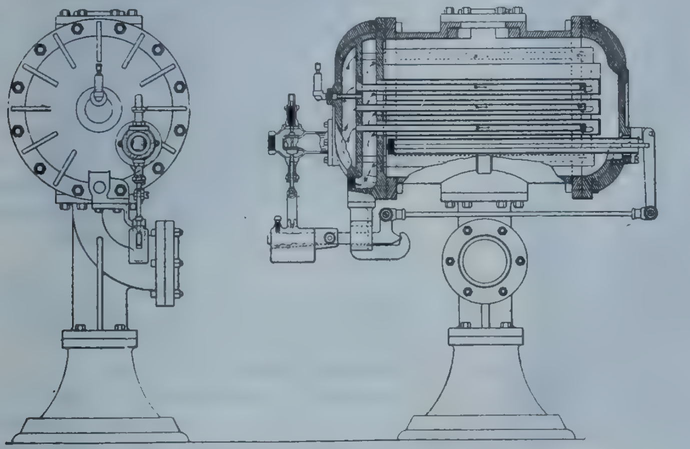
The New Manny Heater.

Among the number of very interesting heaters is that designed and manufactured by the E. S. Manny Co., Montreal. This heater employs an old idea in a new way. The exhaust steam is passed into the heater tubes and the water is heated. This water is the medium through which the heat is carried to the various portions of the building to be heated. The old principle applied is that of the surface condenser, but the manner in which it is employed is unique. The heater is placed upon a pedestal consisting of two cast iron pieces, the upper one of which contains the flanged elbow through which the water enters the heater. The upper flange of the elbow fits to a round machined boss on the cast iron body of the heater. The outlet is similar to the inlet and is placed on top of the heater body. One head of the heater is a simple casting as shown in the cut while the other head to outward appearances is similar to the first, but upon closer examination it is found to differ largely.

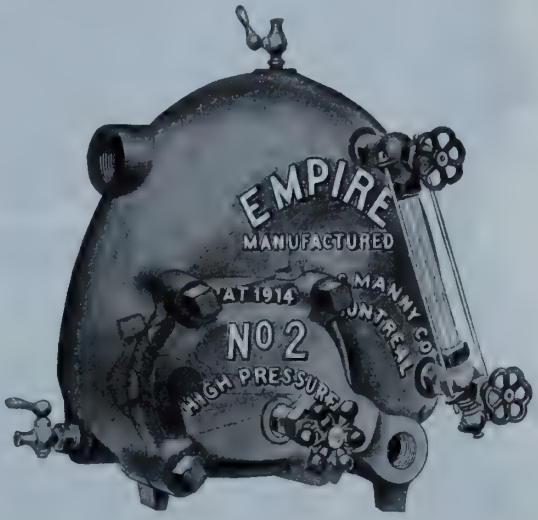
There are two separate cast iron plates in the head, and these serve as a crown sheet in the construction of the heater. The tubes are only fastened at one end, the idea being that, if the brass tubes were fixed at both ends, the expansion of the brass and iron being unequal, would soon cause the tubes to become leaky. The brass tubes are not expanded into the iron plates but are screwed in, and the pipes are not threaded by dies, but in a lathe so they all stand perpendicularly to the plate.



END ELEVATION, MANNY HEATER.



END AND SSECTIONAL VIEW OF MANNY HEATER.



THE MANNY STEAM TRAP.

When in position, the heater is so placed that the tubes are horizontal. The tubes are all screwed in the outer plate of the heater head. In the inner plate of the head, there are screwed small ½ inch brass tubes. These are located concentrically to the larger 1½ tubes, and extend right through the latter to within a few inches of the end. The two chambers in the heater head are entirely separate from one another and are also both separate from the water chamber.

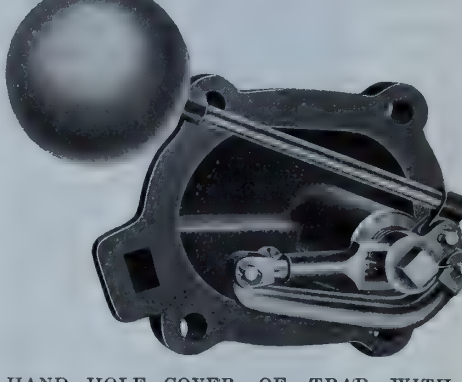
The steam is passed through the inlet and is forced through the ½ inch brass pipes and because the larger brass tubes are plugged with cast iron pipe plugs, the steam after it passes out of the end of the small pipes returns through the annular passage in the large tubes and finally into the chamber formed between two crown plates, from whence it is drawn off through the outlet passage which connects to this chamber.

These heaters are made in five sizes; in all, however, the diameter of the tubes is just the same, the increased heating surface being obtained by using more tubes and increasing their length.

The Manny Steam Trap.

In conjunction with these heaters, a steam trap is often installed; however, these steam traps are also employed in various other cases as well. In long pipe lines, condensation is inevitable, and thus if reasonably dry steam is desired at the end of the line, a device to separate the water from the steam is necessary. In the case of the heaters, it is not economical to use other than exhaust or low pressure steam. The case of the traps is, however, different, because they must be designed to operate under all pressures of steam.

In the Manny steam trap, the mechanism is similar in the low pressure and high pressure designs. The size of the water discharge port is however changed. By referring to the cut an idea of the trap can be obtained. The water chamber is a well proportioned and neat looking casting. The inlet opening is threaded ready to receive the steam pipe. A small air cock is located on the top of the casting and a similar drip cock at the bottom. The gauge glass is fastened to one side. To the hand hole cover at one side of the chamber is attached the whole mechanism. Four cap screws hold this cover in place and by removing these four screws, the cover and mechanism can be quickly removed from the casing without in any way disturbing the pipe connections.



HAND HOLE COVER OF TRAP WITH WORKING PARTS ATTACHED.

Operating Mechanism.

The mechanism is actuated by a seamless copper float ball attached to a brass rod. This rod is attached to a brass bell crank which opens and closes the water drain valve. All the working parts are brass, copper or bronze. The valve opens into a port in the hand-hole cover, which conveys the water around to the port in the body of the casting. This latter port leads to the discharge opening. The outlet is a double one, allowing the water to be piped from either side to the feed water heater or hot well. The outlet, not in use, has, of course, to be plugged.

The two outstanding features of this trap are its simplicity and accessibility.

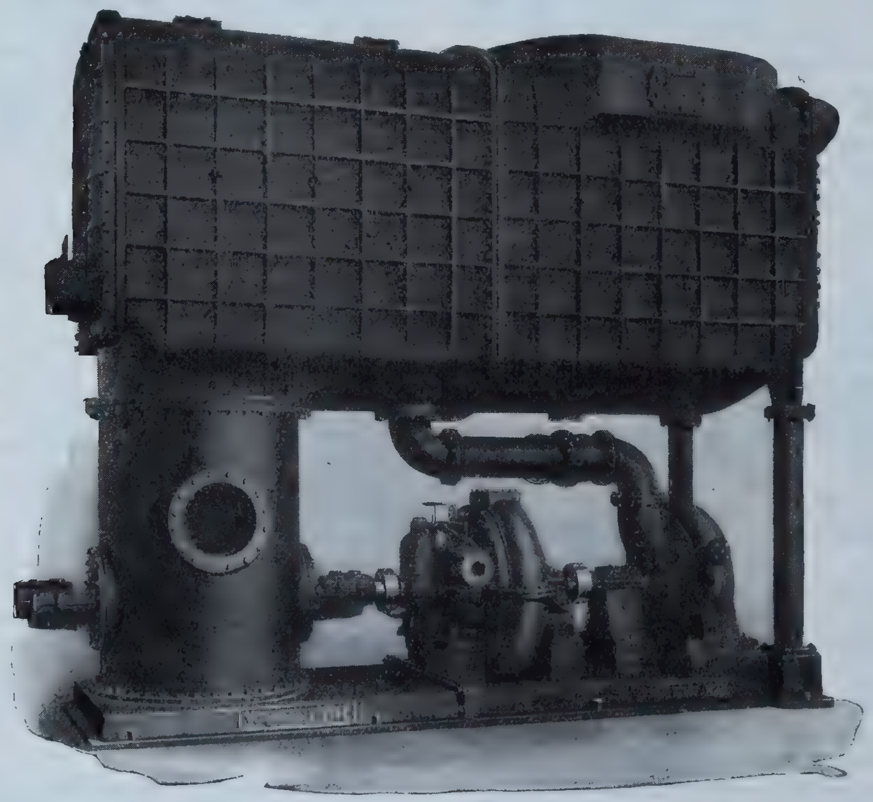
The whole mechanism can be removed from the trap and taken to a place conveniently situated where good light is obtainable to make any repairs or adjustments. Inside the float chamber a rib is cast which fills a dual purpose. The first purpose is to prevent the float from opening too wide the water discharge valve, and the second is to add strength to the sides of the cast iron chamber. When under high steam pressure, this reinforcing rib prevents the sides from spreading.

It is often advisable to quickly get rid of the water of condensation in a cold line of pipes and, to accelerate this, a by-pass is fitted to the trap. By this means the water is quickly gotten rid of. The trap works with steam at atmospheric pressure, but the greater the pressure of steam, the higher up the water of condensation can be forced to a feed heater. The traps are also built in five sizes.

◆

WHEELER RAIN-TYPE COUNTER-CURRENT JET CONDENSER.

A WHEELER rectangular rain-type counter-current jet condenser of latest design, with complete turbine-driven self-contained auxiliaries, is shown in the accompanying illustration. This condenser was supplied to the City of Seattle by the Wheeler Condenser and Engineering Co., Carteret, N.J., and has a capacity of 97,500 lbs. of steam per hour at 28½ inch vacuum. The photograph is taken looking into the discharge of the tail pump, which is of the submerged type and of high-speed design for direct drive by the turbine. The Wheeler turbo air pump is shown to the extreme right and, in the centre, the turbine, which drives both air pump and tail pump. This arrangement makes a very compact and simple unit. The condenser itself is of the well known Wheeler rain-type, counter-current design, with top exhaust entrance, so that the entire condenser and auxiliaries fit directly beneath the turbine.



WHEELER RAIN-TYPE COUNTER-CURRENT JET CONDENSER.

◆

Trade Gossip

The Canadian Fairbanks-Morse Co., Ltd., Toronto, have secured an order for "Skefko" ball bearings for the entire transmission equipment at the new plant of T. R. Eaton & Sons., Ltd., Orillia, Ont.

Canora, Sask.—The Town Council has awarded a contract to Wm. Newman & Co., Winnipeg, for the supply and installation of machinery at a cost of $54,000, in connection with the municipal water system. Chipman & Power, Toronto and Winnipeg, are the consulting engineers.

Montreal, Que.—The City of Montreal recently purchased from E. Laurie & Co., of Montreal, a DeLaval pump, having a capacity of 24,000,000 gallons per day of twenty-four hours. The pump is connected to a 1,625 h.p. multi-stage impulse turbine of DeLaval manufacture by a double helical gear reduction set, also supplied by the same firm. The steam turbine operates at a speed of 3,600 r.p.m., while the pump speed is 600 r.p.m.

Toronto, Ont—The Storey Pump and Equipment Co., Ltd., Toronto, have been awarded the contract for pumping machinery for the new Bishop Strachan College. The contract includes Deane steam pumps and Morris centrifugal pumps with steam turbines.

E. Laurie & Co., of Montreal, report the sale of two DeLaval circulating turbine pumps to be used in the heating system of the new C. P. R. Algonquin Hotel at St. Andrews, N.B. The capacity of the pumps is 420 gallons per minute against a head of 42 feet. They are driven by two DeLaval steam turbines of 10 h.p. each. The pumps are direct connected, the units making a speed of 2,500 r.p.m.

The Graton & Knight Canadian Agency are supplying the belts for the drive at the new Arena ice plant at Montreal, Que. The prime movers are two 100 h.p. motors with 18-in. pulleys. They are belted to two 50-ton ammonia compressors with 12-ft. flywheels. The distance between centres of the flywheel and pulley is 25 ft. The belts are specially built of double-ply leather and have been specially treated with dressing, while the laps have been made especially strong. The belts are 75 ft. long.

Ottawa, Ont.—Sealed tenders for boilers and stokers, feed water heater, steam engines or turbines, generators, switchboard and wiring, will be received at the office of the commissioners of the Transcontinental Railway at Ottawa, Ont., until December 1, 1914, for supplying and installing in accordance with the plans and specifications of the commissioners, of the apparatus above mentioned, in the "Leonard" Locomotive and car shops plant of the National Transcontinental Railway, situated at St. Malo, P.Q. Plans may be seen and form of tender and specifications obtained at the office of Mr. W. J. Press, mechanical engineer, Ottawa, Ont.

C. P. R. Scholarship.—Sir. Thomas Shaughnessy announces, in a special circular, and on behalf of the C. P. R., one free scholarship, covering four years' tuition in the Faculty of Applied Science of McGill University, subject to competitive examination, to apprentices and others enrolled on the permanent staff of the company and under 21 years of age, and to minor sons of employees. This examination will be the regular entrance examination provided for in the annual calendar of the university, and will be held at the university and other

Are Your Boilers Safe?

Many serious boiler explosions have occurred shortly after an Inspector had reported them in good condition. A superficial inspection is worse than none. It is the duty of every steam plant Manager to know the real condition of his boilers.

Scale is responsible for more boiler accidents than all other causes combined, and when its presence is discovered, don't try experiments with patent compound nostrums which require months to learn results, but put a good mechanical Cleaner on the job, that will show immediate results.

A LIBERTY TUBE CLEANER

will remove all the scale in record time, and at a low cost of upkeep. The hard proposition on which other makes of Cleaners have fallen down are what we are looking for.

Write for Catalogue.

Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

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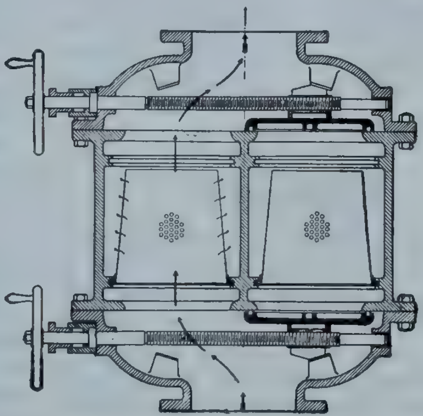

Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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CANADIAN REPRESENTATIVES:
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centres throughout Canada in June, 1915.

Siemens Bros Employees and the War.—The employees of Siemens Brothers Dynamo Works have responded with great enthusiasm to the call to arms. A large number of men from their works and offices at Stafford, amounting in all to about 400, have already joined the forces, and, together with the reservists and volunteers from their head office, branch offices and other departments, the total amounts to over 520. The firm is arranging to keep the posts of all these men open, and ample provision is being made for all the dependents of those who have gone to serve.

The Mesta Machine Co., Pittsburgh, Pa., are now building for the Pennsylvania Steel Co., of Steelton, Pa., two gas blowing engines of 46 in. and 84 in, cylinder diameters and 60 in. stroke. These engines are believed to be the largest gas blowing engines ever built in the United States or on the American Continent. The gas cylinders and blowing cylinder are arranged tandem—that is to say, the air cylinder is directly back of the gas cylinder. An innovation, as far as American gas engines are concerned, is the use of a centre crank instead of an overhung crank. While it is possible to build large engines with overhung cranks, it is considered that the centre crank provides a more rigid construction. All of the company's large reversing engines have been built with centre cranks, and have been universally successful. Finally the blowing tub is equipped with the well known Mesta automatic plate valve (Iversen patent), which, since its introduction in 1911, has been a great success. With these valves, the efficiency of the air end is increased and the cost of maintenance and repairs reduced.

Catalogues

Mazda Fixtures — The Canadian General Electric Co., Toronto, have issued a supplementary to bulletin "F" dealing with the Wheeler multiple Mazda fixtures for street lighting installations. Details are given of the complete fixtures required, accompanied by illustrations and price lists.

Flinn Steam Trap is described in a circular being distributed by Richard T. Flinn, West Roxbury, Mass. The construction and operation of this trap are fully explained, while a sectional view shows clearly the principal features embodied in the design. A few points regarding installation are included while a table gives the capacity and other data for each size of trap.

The Main Belting Co. of Canada, Ltd., have compiled a little booklet, which sets forth the particular services to which their Anaconda and Leviathan belts are best suited. A number of excellent illustrations are given of installations in manufacturing plants. Tables of belt speeds and powers are also to be found, as well as a table indicating the least diameter of pulley that should be used with various belt thicknesses.

Modern Pelton Wheels is the title of a bulletin being distributed by Percy Pitman, Victoria Street, London, S.W., England. The bulletin deals with Pelton wheels for high pressures, stating many suitable applications for this type of water turbine. Pitman's patent governor for regulating the speed of water turbines is described fully and its outstanding features explained in detail. A partial list of installations is included with the bulletin.

The Westinghouse Electric and Mfg. Co. has just issued leaflet No. 3749, covering Westinghouse Synchronous Booster Rotary Converters, in which this type of apparatus is very fully described and illustrated. The advantages of this type of machine are given, together with a detailed account of its method of operation and construction details. A cross section view also gives a clearer understanding of its construction. A number of installation views are also shown.

Steam Engines, built by the Chandler & Taylor Co., Indianapolis, Ind., are described in bulletin No. 128. These engines, which are built for direct connection to electric generators, are described fully, each part being dealt with separately so that a clear understanding of their construction can be obtained by a perusal of the catalogue. The ilustrations show general views of the various types, and also the construction of the various parts. Copies may be obtained from Canadian Allis-Chalmers, Ltd., Toronto, who are the exclusive sales agents for Canada.

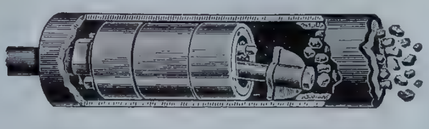
Exide Battery, type "x," for automobile starting and lighting service, is the subject of bulletin, section SL, just off the press. The bulletin contains full particulars of the Exide type "x" battery, including a general description covering the construction. Several assembly diagrams show various different methods of connecting up the batteries, while tables give dimensions for the various combinations. A tabulated list of parts is included with price list; each part being illustrated in the tables. Copies may be obtained from the Canadian General Electric Co., Toronto.

Electrical Appliances, made by the Detroit Fuse and Mfg. Co., Detroit, Mich., are dealt with in an attractive catalogue, No. 22, recently issued. The appliances include the "Detroit" line of ironclad motor starters, sealable entrance switches, fused switches, Arkless enclosed and automobile fuses. Each line is fully described and illustrated, while tables giving the necessary data are also included. Tables of dimensions with diagrams are given for the fused switches and motor starters, while the Arkless fuses are treated in a similar manner. Other apparatus described includes terminals, cut-outs, and contact clips.

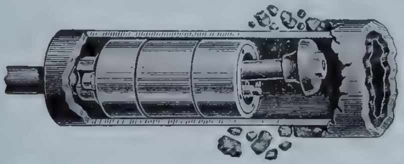
Valves and Fittings made by the Edward Mfg. Co., Chicago, Ill., are dealt with in catalogue No. 5, issued by the company. The Edward valves and specialties described in this catalogue are designed to meet the extreme demands of modern high pressure power plants. Among the principal lines featured are various types of steam stop check and blow-off valves, hydraulic stop and check valves, unions and fittings, etc. Tables of dimensions and price lists are given for each type of product, while in addition are to be found particulars of steam and oil separators and pump governors. The catalogue is fully illustrated.

Turbo-Alternators made by the Canadian Westinghouse Co., Hamilton, Ont., are the subject of bulletin No. 506, recently issued. The bulletin contains some 39 pages devoted to a brief history of the steam turbine and an interesting description covering the design and application of the Westinghouse turbines in particular. Other illustrations show sectional views of various types of turbine and also a number of installations. The concluding pages describe the construction of the generators with illustrations of armature details and field construction.

Steel Chains.—The 1914 edition of catalogue No. 124, having this title is being distributed by the Link-Belt Co., Chicago, Ill. The catalogue deals in an exhaustive manner with the Link-Belt steel chains and sprocket wheels, and contains principally a number of tables giving a great deal of useful information as to details of size and description. In cases where any particular size of chain is not illustrated, information is furnished on separate sheets obtainable from the company. The illustrations include various types of chains and attachments, while with each table is included a diagram showing the type of chain referred to in the table. The chains are listed in order of their strengths, and for convenience of reference a numerical index is included. The catalogue is got up in an attractive manner and will be found exceedingly useful to engineers and superintendents interested in transmission machinery.



The Dean removing scale from the tube of a water-tube boiler.



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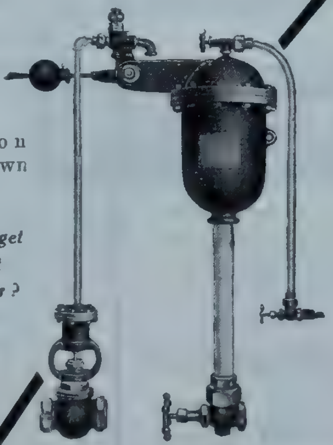

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Book Reviews

Coals Available for Export Trade, by Van H. Mannings, is the title of bulletin No. 76, published by the Bureau of Mines, Department of the Interior, Washington, D.C. The purpose of this bulletin is to describe briefly the general character and commercial quality of some of the coals mined in the United States that reach tide water shipping points, and to show in a general way the important characteristics of those coals that are most available for export. A map is included showing location of coal fields and shipping ports for the fields.

Thermal Properties of Steam, by G. A. Goodenough, is the title of bulletin No. 75, published by the University of Illinois, Urbana, Ill., in connection with the Engineering Experiment Station. This publication, the author of which is professor of thermodynamics at the university, contains 69 pages of matter dealing with the thermal properties of steam. In the introduction a statement is made that the purpose of the bulletin is to exhibit the development of a general theory which apparently gives with extreme accuracy the products of saturated and superheated steam over a range of pressure and temperature far wider than the range covered in technical applications. In order to make the presentation more useful, and perhaps more intelligible, it has been considered advisable to include (1) a section on thermodynamic relations and (2) a section devoted to a brief historical review of some of the more important and analytical investigations. Including the introduction, there are six chapters, which have the following headings:—Thermodynamic Relations; Review of Earlier Investigations; Development of a General Theory of the Properties of Steam; Resume of Formulae, and the concluding chapter embraces a number of tables and a summary. The bulletin contains 16 curves and 18 tables. This exceedingly interesting and useful publication can be obtained from the Engineering Experiment Station, Urbana, Ill., on payment of 35 cents.

The Calculus for Engineers, by Ewart S. Andrews, B.Sc. Eng. (Lond.) and H. Byron Heywood DSc. (Paris), B.Sc. (Lond.), 269 pages, 7½ x 4½ ins., 102 illustrations; indexed; published by Scott, Greenwood & Son, 8 Broadway, Ludgate, E.C., London; price $1.00 net. It is generally admitted that the standard courses of pure mathematics as taught in schools and colleges are not well adapted to form part of the training of engineers. Mathematics, however, forms a large and essential part of his work. In fact mathematics that is not in such form that he can directly apply to his practical problems, is of no use to him. The joint authorship of this book by a mathematician and an engineer has assisted greatly in realizing the purpose of the book—that of applying the calculus to engineering problems rather than modifying engineers' methods to suit standard mathematics. A feature of the book that cannot help but impress the most casual examination is that a thorough knowledge of the allied branches, analytical and descriptive geometry are not required in order to master the calculus as required by engineers. For this reason it will be appreciated, not only by seasoned men, but by beginners as well. Graphical methods, always popular with the practical man are adopted wherever possible throughout. One of the most noteworthy differences between this work and others is in the order in which the different branches of the subject are taken up. The first chapter leads the student from a discussion of the functions of physical quantities and numbers through those of variable quantities, the use of graphs, derived curves, sum curves, etc., to the measurement of areas. Chapters II. and III. deal with the laws both algebraical and exponential which govern the various curves and graphs met with in practice. Chapters IV. and V. deal with differentiation including successive differentiation, maxima and minima, point of inflection, etc., showing the direct relation of these laws to the steam engine mechanisim in problems of velocity acceleration, etc. Integration is taken up in chapters VI. and VII., and the practical applications given become more interesting. These include work done in engine cylinder, centres of gravity, moments of inertia, problems in flow of water, deflections of beams and many others. Chapters VIII. and IX. go a little further into differentiation dealing with several independent variables, differential equations, harmonic motion, Enler's formula for columns, etc. Chapter X. handles a number of special curves in a very interesting way, namely the catenary, involute, cycloid and others, as well as radius of curvature. Besides this there is an appendix of mathematical tables including, exponential and hyperbolic functions, hyperbolic logs, trigonometric functions, tables of squares, areas of circles metric equivalents, etc. The book as a whole differs from most works on the calculus in that it is so arranged to permit students to approach the subject with less preliminary study. Branches of the subject of no use to engineers have been eliminated and the lack of any needless words in its exposition give evidence of an enormous amount of patience and rewriting on the part of the authors. A notable feature also is the completeness and practicability of the illustrative examples contained, these being attached to every theory advanced

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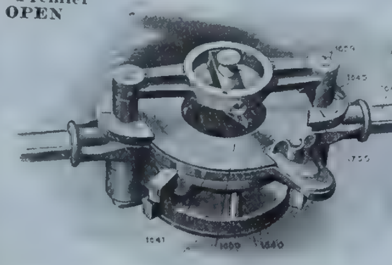

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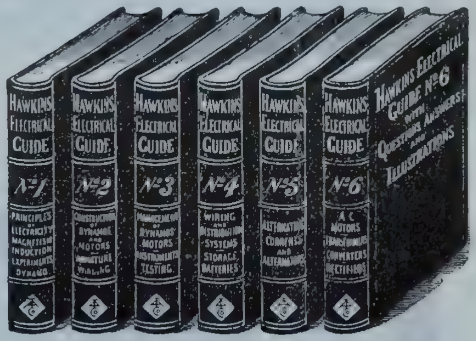
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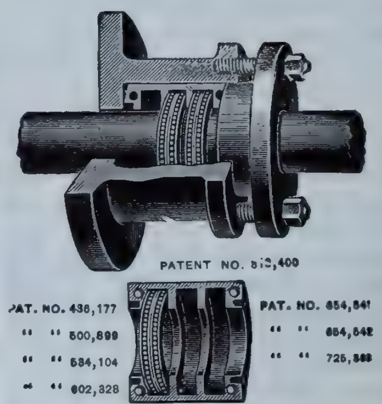
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of
Steam Boilers.



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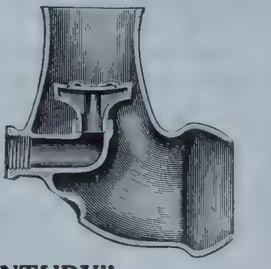

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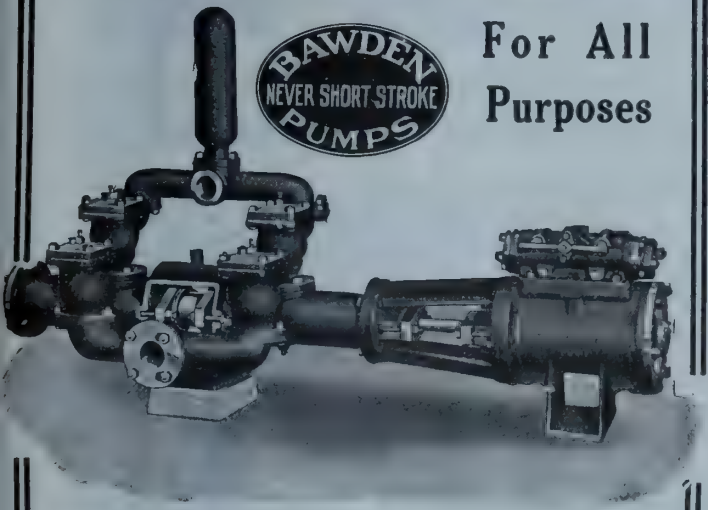

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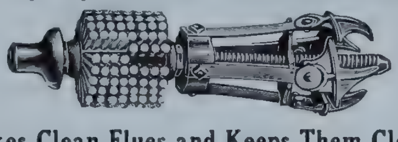

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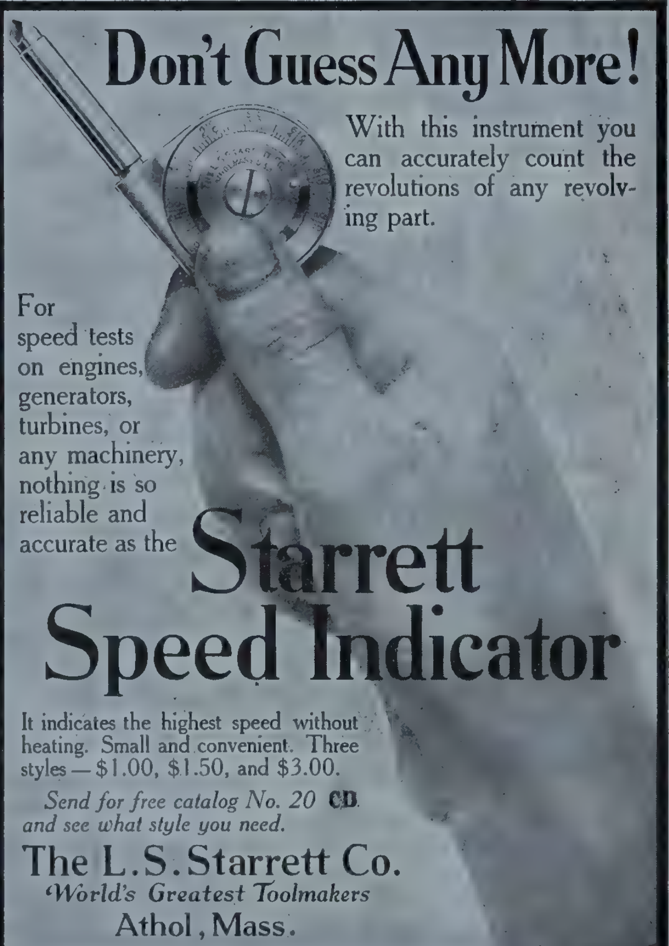

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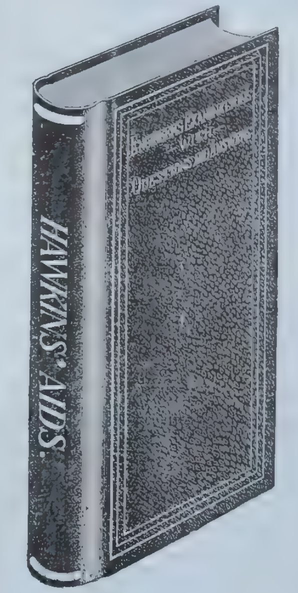
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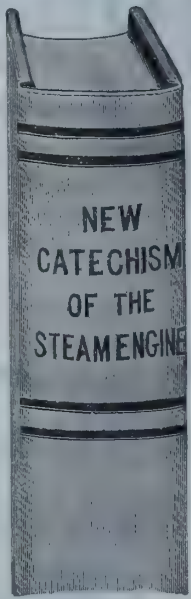
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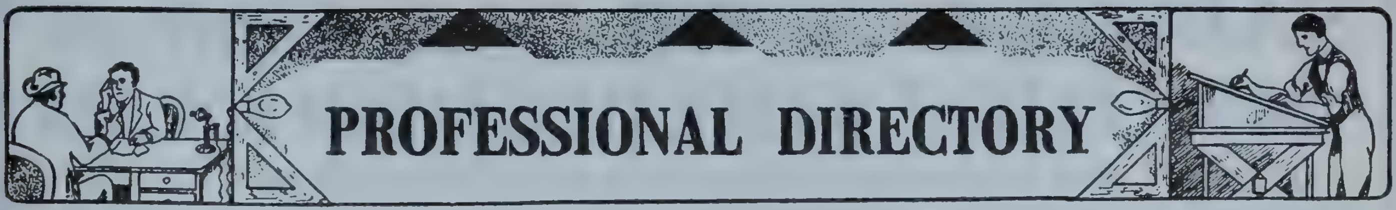

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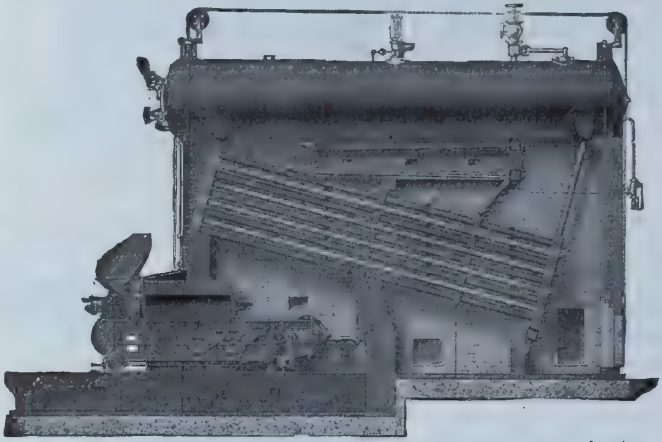

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Theodore Kipp Co., Winnipeg.
Terry Steam Turbine Co., Hartford, Conn.
Northern Electric Co., Ltd., Montreal.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal
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Elevators.
John McDougall Caledonian Iron Works, Montreal.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

Emulsive Hard Cutting Oil.
Commercial Oil Co., Hamilton.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Engines, Automatic and Drop Valve.
Can. Allis-Chalmers, Ltd., Toronto.
Frick Co., Waynesboro, Franklin Co.,
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

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W. H. Allen Son & Co., Bedford, Eng.
Can. Allis-Chalmers, Ltd., Toronto.
Boving & Co. of Canada, Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Smart-Turner Machine Co., Ltd., Hamilton.

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W. H. Allen Son & Co., Bedford, Eng.
Boving & Co., of Canada, Limited, Toronto.
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Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
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Theodore Kipp Co., Winnipeg.
Waterous Engine Works Co., Brantford.

Engines, Marine.
W. H. Allen Son & Co., Bedford, Eng.
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John Inglis Co., Ltd., Toronto.
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Laurie & Lamb, Montreal.
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Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Can. Allis-Chalmers, Ltd., Toronto.

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W. H. Allen Son & Co., Bedford,
Boving & Co., of Canada, Limited, Toronto.
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Laurie & Lamb, Montreal.
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Waterous Engine Works Co., Brantford.

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.

Engineers' Supplies.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.

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W. H. Allen Son & Co., Bedford, Eng.
Terry Steam Turbine Co., Hartford, Conn.

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Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Terry Steam Turbine Co., Hartford, Conn.
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Expansion Joints.
Lunkenheimer Co., Cincinnati, O.

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B. F. Sturtevant Co., Boston, Mass.
Sheldons, Limited, Galt, Ont.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
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Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Chaplin & Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.

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John McDougall Caledonian Iron Works, Montreal.
Siemon Co., Toronto.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.
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Siemon Co., Toronto.

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Jones Cold Store Door Co., Hagerstown, Md.

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American Pulley Co., Philadelphia.

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Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

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Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

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Jones Cold Store Door Co., Hagerstown, Md.

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Graton & Knight Mfg. Co., Montreal.

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John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert.

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Fuses, Renewable.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Economy Fuse & Mfg. Co. of Canada, Montreal.
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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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Durabla Mfg. Co., New York.
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Frick Co., Waynesboro, Franklin Co.
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Garlock Packing Co., Hamilton, Ont.
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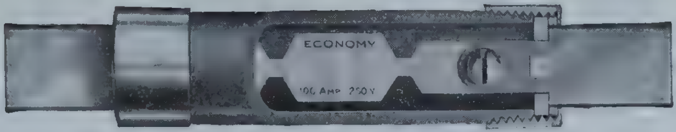

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Canadian General Electric Co., Ltd., Toronto.
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Northern Electric Co., Ltd., Montreal.
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Gongs.
Northern Electric Co., Ltd., Montreal.

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Can. Allis-Chalmers, Ltd., Toronto.

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Commercial Oil Co., Hamilton.
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Graphitol.
C. C. Snowdon, Calgary.

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Detroit Lubricator Co., Walkerville.
Lunkenheimer Co., Cincinnati, O.
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Jos. Dixon Crucible Co., Jersey City.
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Graton & Knight Mfg. Co., Montreal.

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Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

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Can. Allis-Chalmers, Ltd., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
John Inglis Co., Ltd., Toronto.
E. S. Manny Co., Montreal.
Theodore Kipp Co., Winnipeg.
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W. H. Allen Son & Co., Bedford, Eng.
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Bawden Machine Co., Toronto.

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Arctic Ice Machine Co., Canton, Ohio.
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Linde Canadian Refrigeration Co., Montreal.
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Canadian General Electric Co., Ltd., Toronto.
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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
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Can. Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
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Can. Detroit Lubricator Co., Walkerville, Ont.

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Lunkenheimer Co., Cincinnati, O.
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Penberthy Injector Co., Windsor.

Instruments.
Northern Electric Co., Ltd., Montreal.

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L. S. Davis Co., London, Ont.

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Commercial Oil Co., Hamilton.

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Graton & Knight Mfg. Co., Montreal.

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Canadian General Electric Co., Ltd., Toronto.
Can. Sunbeam Lamp Co., Toronto.
L. S. Davis Co., London, Ont.
Northern Electric Co., Ltd., Montreal.

Lamps, Arc, Incandescent.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
Northern Electric Co., Ltd., Montreal.

Leather Strapping.
Graton & Knight Mfg. Co., Montreal.

Lubricants.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
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Commercial Oil Co., Hamilton.

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Darling Bros., Montreal.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
C. A. Dunham Co., Ltd., Toronto.
Can. Detroit Lubricator Co., Walkerville, Ont.
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Terry Steam Turbine Co., Hartford, Conn.

Magnetos.
Northern Electric Co., Ltd., Montreal.

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Babcock & Wilcox, Montreal.
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Northern Electric Co., Ltd., Montreal.

Metal Spools.
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Meters, Electric.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
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Meters, Water.
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W. H. Allen Son & Co., Bedford,
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Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
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Bawden Machine Co., Toronto.

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S. F. Bowser & Co., Inc., Toronto.
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Goetze-Gasket & Packing Co., New Brunswick, N.J.
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Goodyear Tire & Rubber Co., Toronto.
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Garlock Packing Co., Hamilton, Can.
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Goodyear Tire & Rubber Co., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

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Canadian H. W. Johns-Manville Co., Toronto.
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Durabla Mfg. Co., New York.
Garlock Packing Co., Hamilton, Can.
Goodyear Tire & Rubber Co., Toronto.
Greene, Tweed & Co., New York.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
Graton & Knight Mfg. Co., Montreal.

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Lake Erie Mfg. Co., Inc., Buffalo, N.Y.

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Waterous Engine Works Co., Brantford.

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Bawden Machine Co., Toronto.
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Waterous Engine Works Co., Brantford.

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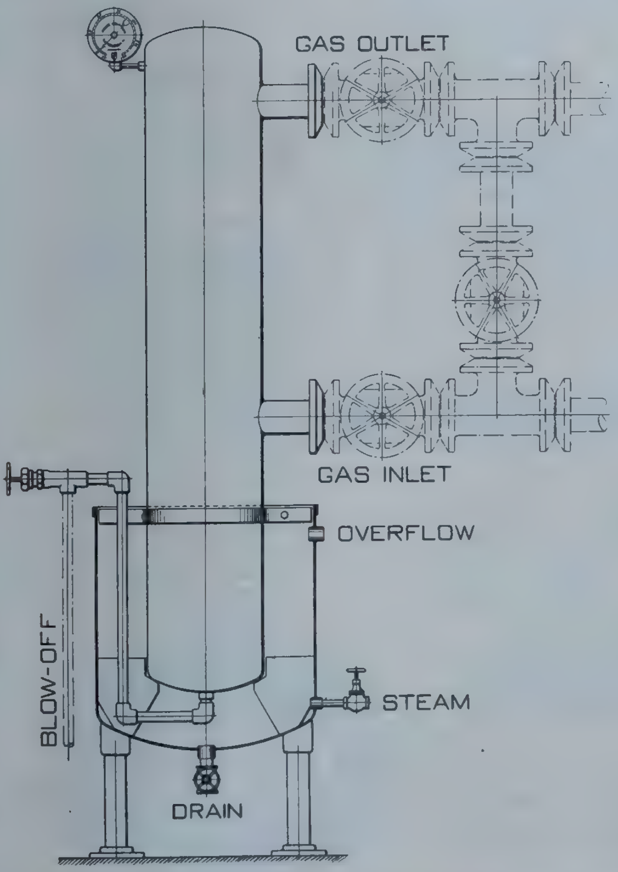

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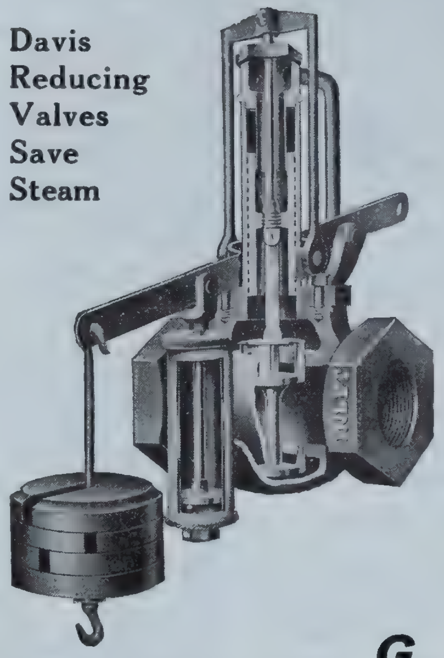

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THE "MADE IN CANADA" REDUCING VALVE

**J.M.T.
Reducing
Valve**

**Sizes
½" to 2"**

**The Utmost
in
Reducing
Valve
Perfection**

**Ranges
2 lbs. to 300 lbs.**

Non-Equalizing.
Extremely Sensitive.
Results Absolutely
Guaranteed.
Interested?

THE JAMES MORRISON BRASS MFG. CO., LIMITED
Engineers' and Plumbers' Supplies
TORONTO - - - - - - - ONTARIO

CIRCULATES IN EVERY PROVINCE IN CANADA

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas
Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg.
TORONTO: 143-153 University Ave.
LONDON, ENG.: 88 Fleet St. E.C.
WINNIPEG: 34 Royal Bank Bldg.

Vol. VII
Publication Office, Toronto—December, 1914
No. 12

Manufactured by
Penberthy Injector Co., Limited, Windsor, Ontario

"INGLIS" BOILERS

For Any Service

Marine Boiler built for R. & O. Nav. Co. Str. "Rapids Prince"

"Inglis" Boilers are the best. We make all kinds for any service. We are also Sole Canadian Manufacturers of the well-known Erie City Water Tube Boilers, Vertical and Horizontal.

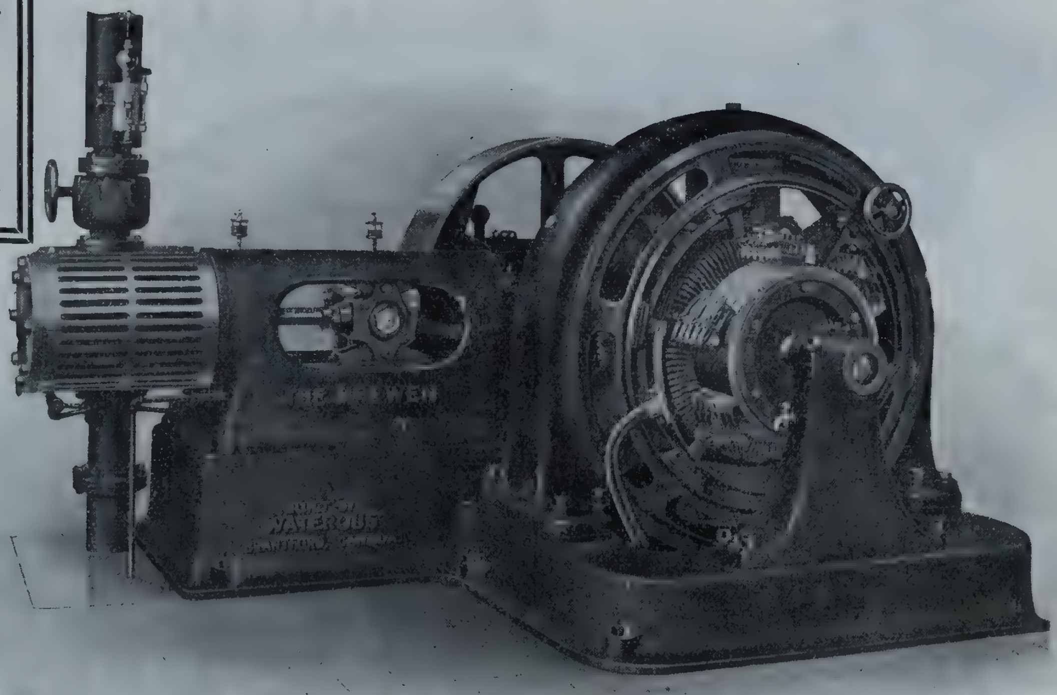
WRITE US.

The John Inglis Company, Limited

ENGINEERS AND BOILERMAKERS

14 Strachan Ave., Toronto. Montreal Office, 509 Can. Express Bldg.

**We Build
Complete
Power Plant
Equipment
for Every
Installation**



McEWEN HIGH-SPEED AUTOMATIC ENGINE

These dependable engines are built for continuous duty. They are your best insurance against costly repair bills and unexpected shut-downs.

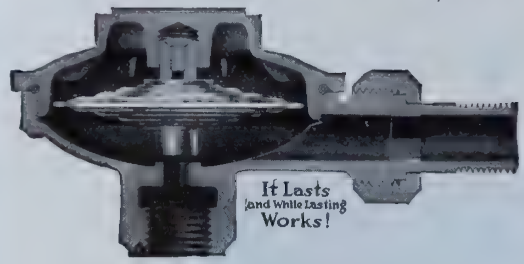
They operate quietly and smoothly with an exceedingly close regulation under fluctuating loads. Sturdiness and their large reserve capacity enable them to respond instantly to heavy peak load demands.

Your careful investigation of their actual service performance record in all parts of the country is specially requested. Let us send you our list of McEwen users.

Built in simple and compound units up to 700 H.P. capacity. May we send you descriptive literature?

THE WATEROUS ENGINE WORKS CO., Ltd.
BRANTFORD, CANADA

DUNHAM RADIATOR STEAM TRAPS



Cross section of Dunham Radiator Trap

Prevent Steam Waste!

While you are seriously thinking about cutting down operating expenses—don't overlook the—Heating System.

Many are the conditions under which the use of a Dunham Radiator Trap will effect a considerable saving and render untold service in convenience.

Perhaps you have an unsatisfactory Vacuum System — out-of-date, non-working traps.

A Dunham Radiator Trap on trial will show you what can be accomplished. We will gladly send one on request, together with information and descriptive Bulletins 5 and 6.

"Made in Canada."

C. A. DUNHAM CO., Ltd., TORONTO, CAN.

MONTREAL—Room 20, 11 St. Sacrament St.
FORT WILLIAM—Plumbing & Engineering Supply Co.
HALIFAX—General Contractors Supply Co., Ltd., McCurdy Bldg.
VANCOUVER—520 Duncan Bldg.
CALGARY—Metals, Limited.
WINNIPEG—405 Tribune Bldg.

Hoyt "Frost King"

(Made in Canada)

Our 40 YEARS' EXPERIENCE IN SELECTING AND MIXING OF METALS has resulted in an alloy of highest perfection. A careful microscopic examination of the grain will verify this claim.

Hoyt **"FROST KING"** is especially designed for saw mills, planing mills, threshing machines, traction engines, pumps, rolling mills and pulp machinery, and all classes of **stationary** engines. You will also find Hoyt "NICKEL GENUINE" exceptionally good for babbitting dynamos and motors.

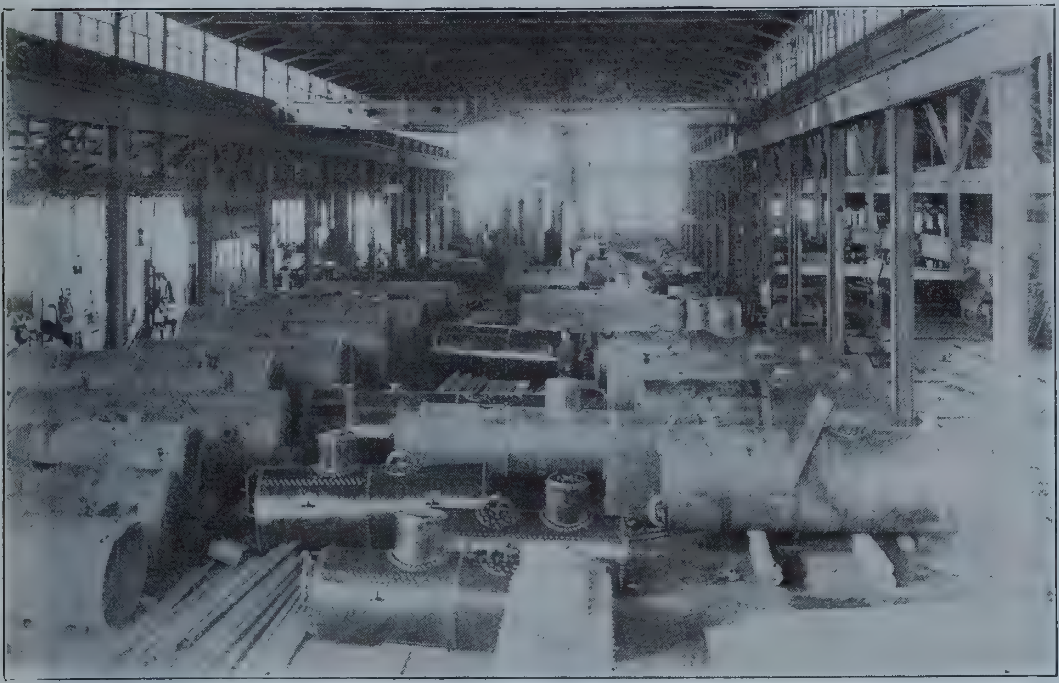
If you cannot get these babbitts from your dealer, we shall be pleased to make you a shipment of a twenty-five pound box.

OUR MIXED METAL SALES AMOUNT TO OVER 5,000,000 DOLLARS ANNUALLY. This enormous turnover has reached its present stage through the distinctive service-giving qualities of our products.

Hoyt Metal Co., Toronto, Ont.

London, Eng. **New York, N.Y.** **St. Louis, Mo.**

Jenckes Boilers



Our Boiler Department with Boilers in Various St ages of Construction

Horizontal Tubular,
Vertical Tubular,
Locomotive Types,
Heating Boilers

Made for **Low, Medium** and **High Pressures,** of the various standard styles and to **pass any inspection.** Our experience and scrupulous care at every step of construction assure users of Jenckes Boilers LONG SERVICE WITH MINIMUM STOPPAGE FOR REPAIRS.

Write for catalog and particulars.

The Jenckes Machine Co., Limited

Sherbrooke, Montreal, St. Catharines, Toronto, Cobalt, South Porcupine, Nelson, Vancouver.

Works at
Sherbrooke, Que., and
St. Catharines, Ont.

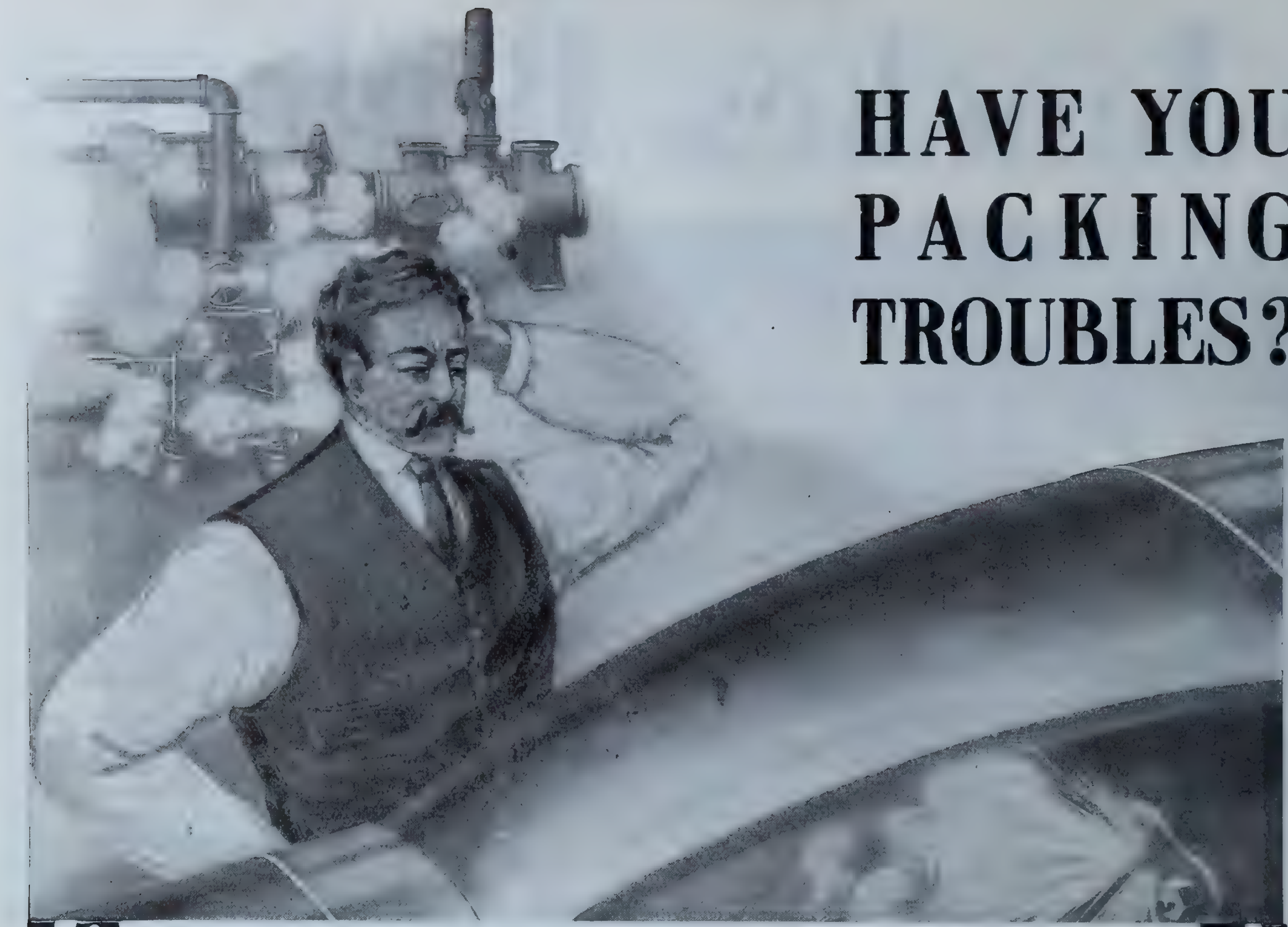
KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**



HAVE YOU PACKING TROUBLES?

Packing troubles are easily prevented if you use a packing that heat cannot affect, and is so perfectly lubricated in each strand that it does not harden in service.

WHY DON'T YOU TEST THE TROUBLE-SAVING QUALITIES OF

TRADE MARK

"PALMETTO" PACKING

REG. U.S PAT. OFFICE

It's made to meet hard conditions.

Can we send you a free WORKING SAMPLE? OUR SALESMEN WILL NOT TROUBLE YOU.

GREENE, TWEED & CO.

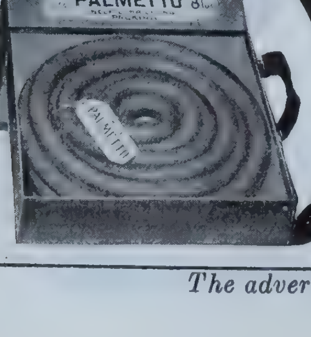
Sole Manufacturers

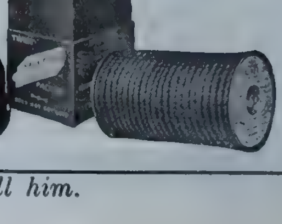
109 Duane Street, New York

Canadian Distributing Agents:—

The Canadian Fairbanks-Morse Co., Limited

Montreal, Ottawa, St. John, Toronto,
Winnipeg, Calgary, Saskatoon
Victoria, Vancouver





Where Will You Spend Your Christmas?

Will it be at home with "mother" and the kiddies at Christmas dinner—the turkey "done to a turn," the crisp celery, the juicy cranberries and all the other fixin's making your mouth water—or will you spend the day in the engine room sweating and stewing over a lot of rods packed with "just-as-good" or other stuff that binds and scores, and makes your engine thump, labor and blow?

There will be hundreds of the "boys" home with their families Christmas this year who have spent many other holidays at the plant before they began using trouble-saving P.P.P.

DANIEL'S ROD PACKING

P.P.P.

Reg. U. S. Pat. Off.

FOR STEAM, AIR, WATER, AMMONIA.

Here's a straight tip from one of your fellow engineers: "I am a stationary engineer, and having run all kinds of engines, during my experience packing these engines, I have used most every packing known. To my satisfaction, I find P. P. P. Rod Packing the best I have ever used. I truly believe that every engineer will say what I do about the packing after using it once. I now use P. P. P. Rod Packing all the time and find it cuts out the Sunday work packing engines."

We Wish You
A Happy Christmas

License Examination Book, FREE

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineer's License Examinations absolutely FREE.

Your name ....
Address ....
Employed by ....
Address ....
Horsepower of engine ....
Brand of Rod Packing used ....
Form of Packing Used—Coil ☐Spiral ☐Ring ☐Check X
Name of Buyer ....
....Series 24-L

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, Pa., U.S.A.

Leaky Joints Are Made Permanently Tight with

Jenkins Rubber Co., Elizabeth, N.J., where "Jenarco" is made.

JENARCO

Jenkins Bros.' New Sheet Packing

This splendid product is a high-grade semi-vulcanized sheet rubber packing that possesses extreme toughness and flexibility. It is not influenced by climatic conditions and does not deteriorate in storage.

Engineers and steam fitters strongly recommend its use. They have learned by experience that Jenarco will make an absolutely tight and durable joint under service conditions where ordinary packings fail.

Jenarco is equally dependable for high pressure steam, hot or cold water and other liquids which do not attack rubber.

Jenarco is very light in weight and is therefore less expensive per square yard than most other packings. It is regularly made in sheets 36 inches wide, in rolls of about 110 or 220 lbs. each. Other widths made to order. Also manufactured with wire insertion.

If you do not find "Jenarco" exactly as represented—return it at our expense. You take absolutely no risks by a trial.

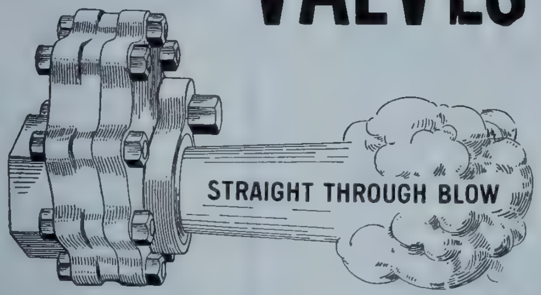
Order "Jenarco" from your dealer to-day.

Write for copy of our Catalog. It's free.

JENKINS BROS., LIMITED

103 St. Remi St., Montreal

EVERLASTING Blow-Off VALVES



No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 200,000 in use

"EVERLASTING" Blow-Off Valves will **immediately end your blow-off leaks or troubles.**

We guarantee **perfect service.** Any failing to give satisfaction within one year from date of installation will be replaced, or your money refunded if desired.

They have been registered and approved of by the following Provincial Governments: — Ontario, Saskatchewan, Alberta and British Columbia.

Sold strictly on merits — try them.

Look for this MARK ☞

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Ltd.

1080 King St. West, Toronto

MONTREAL, QUE.
H. L. Peiler & Co.

CALGARY, ALTA.
P. D. McLaren, Ltd.

VANCOUVER, B.C.
Taylor-Forbes Co., Ltd.

WINNIPEG, MAN.
The A. R. Williams Mach. Co.

At Least 5% of your power is wasted by rod friction

It is estimated that rod friction, caused by soft packing, consumes at least 5 per cent. of an engine's power.

Rather interesting, when you consider that this means a waste of 5 per cent. of the coal which creates the power.

With soft packing it is necessary to screw the gland tight—in order to prevent leakage of steam. Thus the friction is constant—always acting on the piston like a brake.

J-M

SEA RINGS

Eliminate 75% of this friction

This means that you can cut your present fuel bill approximately 4%.

Figure it out yourself.

Then ask yourself whether such a saving is worth while in your plant.

J-M Sea Rings are automatic in action. Their pressure on the rod is exactly in proportion to the pressure on or through them.

Steam enters the hollow space between the "lip" and the "heel," forcing the "lip" against the rod with just enough pressure to prevent leakage.

J-M Sea Rings are self-lubricating.

And withstand highest temperatures and pressures.

Ideal for superheated steam, high pressure hydraulics, marine engines, hot and cold water pumps, etc.

Write nearest branch to-day for our illustrated Blue Book

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos Packings; Pipe Coverings; High Temperature Cements; Boiler Preservative; Conduit; Metallic Hose; Fuses; Boiler Plugs; Stack Lining; Tube Cleaners; etc.

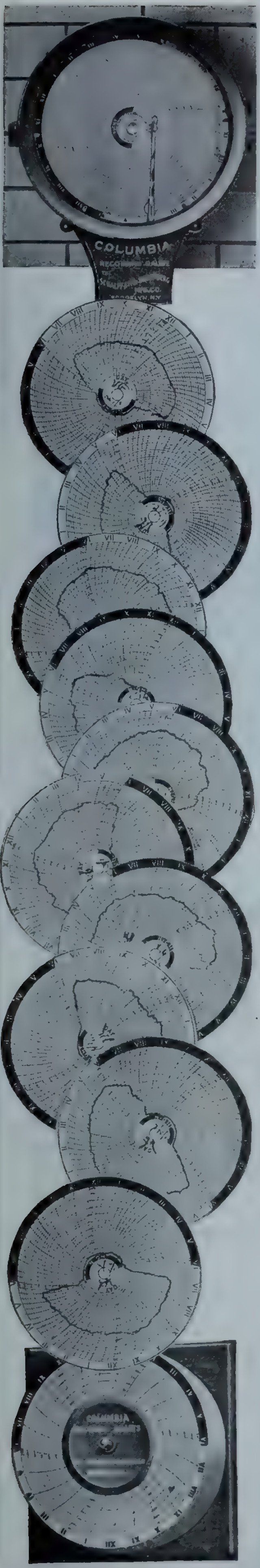
TORONTO **WINNIPEG**
MONTREAL **VANCOUVER**

2308

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Good health
and good
luck throughout
the coming year

DART UNION COMPANY, LTD.
TORONTO



A Prize Contest

In Which Every Live Engineer Should Take Part—

HERE is an opportunity to demonstrate your skill as an Engineer and win a prize well worth having. We have planned a mighty interesting prize contest which will be sure to appeal to you. We will call it the Engineers' Efficiency Contest. It is a contest of skill for Engineers only and every Engineer in charge of a Power Plant, no matter how small, is qualified to take part.

We cannot attempt to explain the Engineers' Efficiency Contest here, for we haven't the space. But fill in and send us the coupon. We will then enroll you and forward complete information.

WORTH $50.00 **The Prize** **WORTH $50.00**

A N S & B Hand Tachometer with complete equipment worth $50.00 — the most popular and finest type of Hand Tachometer we make. An Instrument which any Engineer will be proud to possess. Or, if you can't use a Tachometer you can select any Instrument from our complete line for Power Plant Testing to the value of $50.00.

We will make no further announcement of this contest, so fill in the coupon Now—be sure you give all the information asked for.

THE
Schaeffer & Budenberg MFG. CO.
Indicating and Recording THERMOMETERS, GAUGES AND TACHOMETERS, INDICATORS, CALORIMETERS, COUNTERS, GAUGE GLASSES, TESTERS, ETC., ETC.

Brooklyn, N. Y.

Fill in this coupon and we will enroll your name in the Engineers' Efficiency Contest and send full particulars of same.

Write Plainly.

Are your Boilers Equipped with Recording Gauges?

How many Recording Gauges Have You?

What Make are the Recording Gauges?

How many Boilers are not equipped with Recorders?

Do you advocate the use of Recorders?

Your Name?..................

Firm Name?..................

Firm Address..................

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

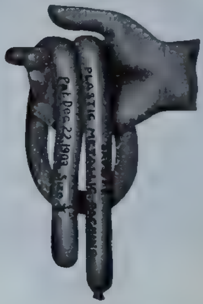
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for **FREE SAMPLE** and particulars.

Manufactured only by

STEEL MILL PACKING CO., WINDSOR, ONT.

Practically Frictionless



Any Quantity sent
on APPROVAL

The Safe and Sure
METHOD

RED STAR BOILER COMPOUND

The Most Convincing Proof of the Merits of a Product is—
"WHAT IT HAS DONE"

For years the RED STAR METHOD for maintaining clean and efficient Boilers has been used with eminent success, proving over and over again the merits of RED STAR PRODUCTS.

SCALE (the arch enemy of the steam user) cannot exist, neither can it form, where the proper formula of Red Star Feed Water Treatment is used according to our directions, and we court the most rigid tests as to its reliability.

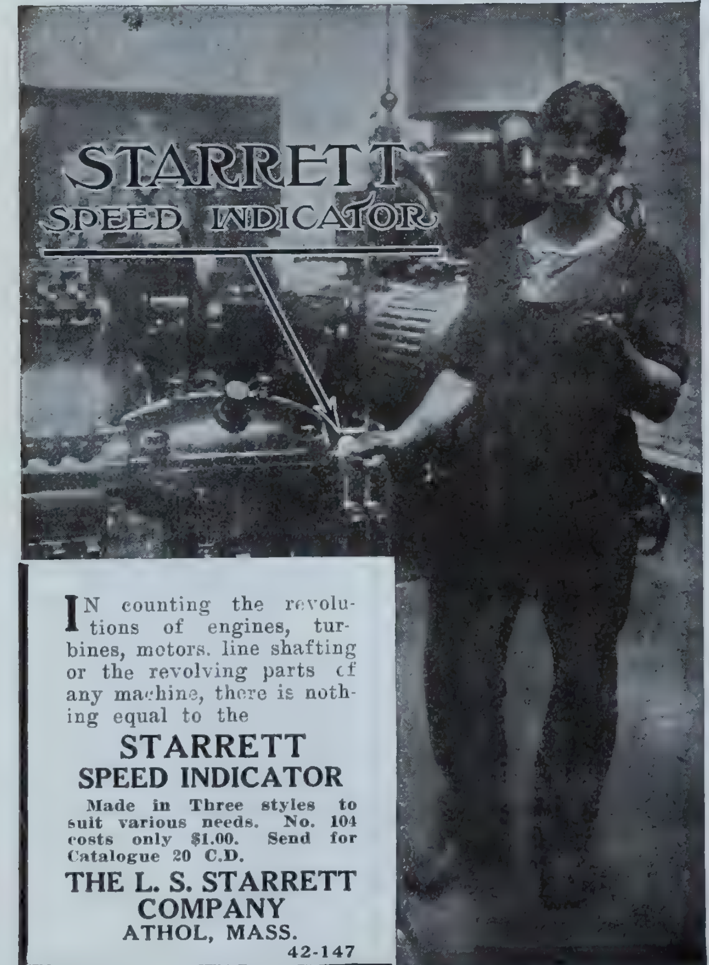
Steam Plants that commenced using RED STAR more than a decade ago, are using it to-day. Would this be true if it had not accomplished what we claim?

Don't experiment with inefficient compounds, but write us for full particulars regarding the use of RED STAR, the Feed Water Treatment that keeps the boiler clean.

LAKE ERIE MANUFACTURING CO., Inc.

Home Office and Factory:
192-198 Chicago St., Buffalo, N.Y., U.S.A.

Canadian Sales Agent: GRANT H. POWELL,
81-85 Victoria St., Toronto, Ont.



IN counting the revolutions of engines, turbines, motors, line shafting or the revolving parts of any machine, there is nothing equal to the

STARRETT SPEED INDICATOR

Made in Three styles to suit various needs. No. 104 costs only $1.00. Send for Catalogue 20 C.D.

THE L. S. STARRETT COMPANY
ATHOL, MASS.

42-147

"Magic" Advt. No. 2.

Two Valuable Aids
TO THE
Stationary Engineer

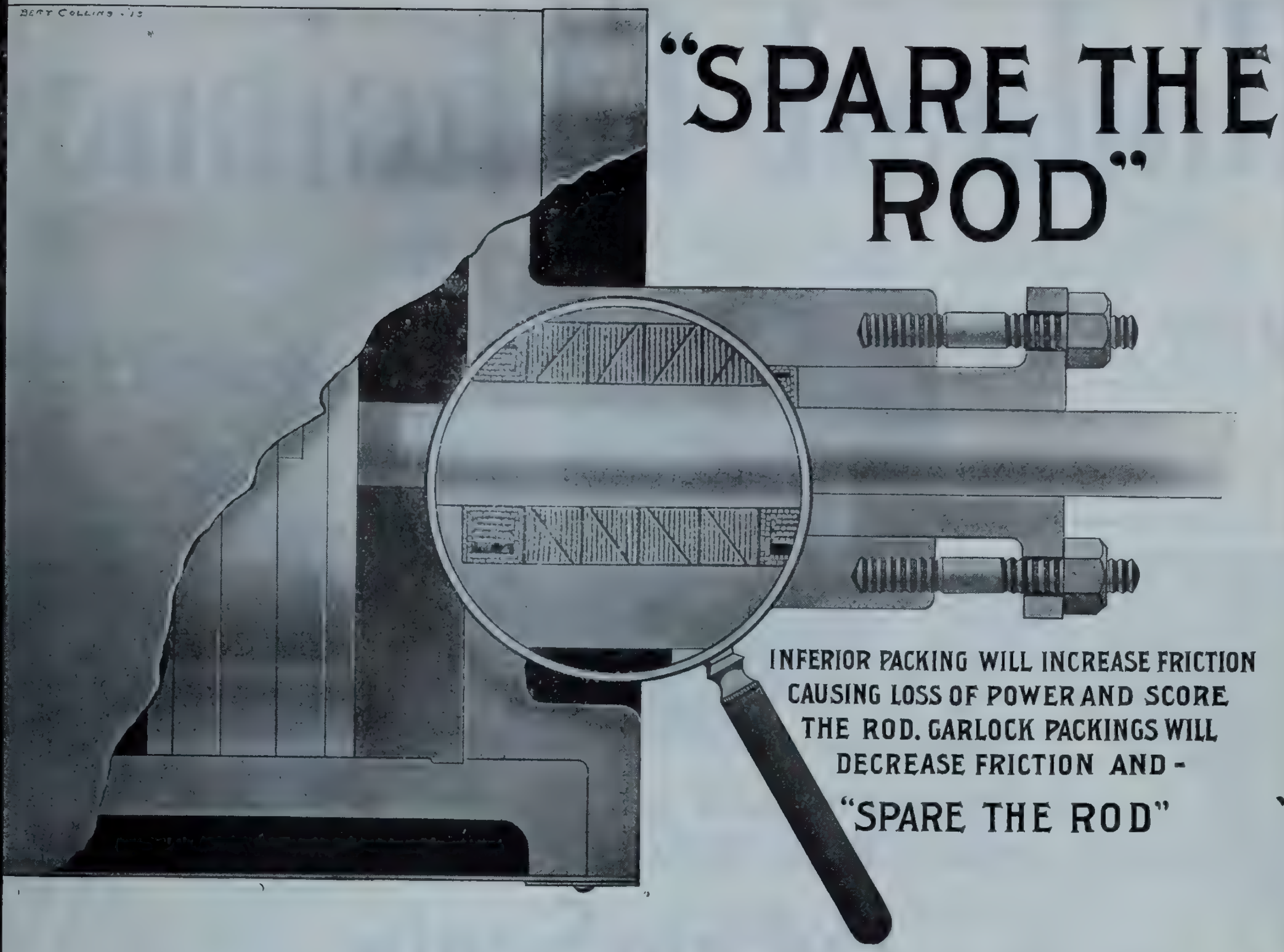
1. "Magic" Boiler Preservative
2. Fine Tools

Did you read our offer of a box of fine tools free? It was in the January number and if you have not notified us yet that you want these tools, hunt up your January POWER HOUSE, and cut out our advt.—then send us word right away that you would like one of these tool boxes. This is **for engineers only.**

(1) You have the tangible object of securing the tools.

(2) You will be certain to learn the advantages of employing "MAGIC" Boiler Preservative. It is the best that science can devise and will save money for your employers. And when you save money for your firm you increase your own value to them. Don't wait to read all the "MAGIC" advts. in order to learn all the advantages it possesses, but write for our pamphlet, which will be sent postpaid to you, if you mention your position. Also send in your name for those tools—we want to get acquainted.

S. L. Davis Co., Limited
London, Ont.


BERT COLLINS '15
"SPARE THE ROD"
INFERIOR PACKING WILL INCREASE FRICTION CAUSING LOSS OF POWER AND SCORE THE ROD. GARLOCK PACKINGS WILL DECREASE FRICTION AND -
"SPARE THE ROD"

The above suggestion for an ad, together with the drawing from which plate was made, was submitted to us by a young engineer who is studying mechanical illustrating and designing. We are always disposed to encourage our engineer friends who make efforts to improve themselves; therefore, we accepted the idea and drawing for our ad.

GARLOCK PACKINGS are made in over two hundred styles and combinations to meet every known requirement. We will assume entire responsibility in selecting the proper styles or combinations of our packings to work successfully and economically under any stated condition; and if goods are not wholly satisfactory to purchaser we will refund promptly the cost of same. A card will bring our new catalog, which fully describes our various styles of packings.

THE GARLOCK PACKING COMPANY

HAMILTON, ONTARIO

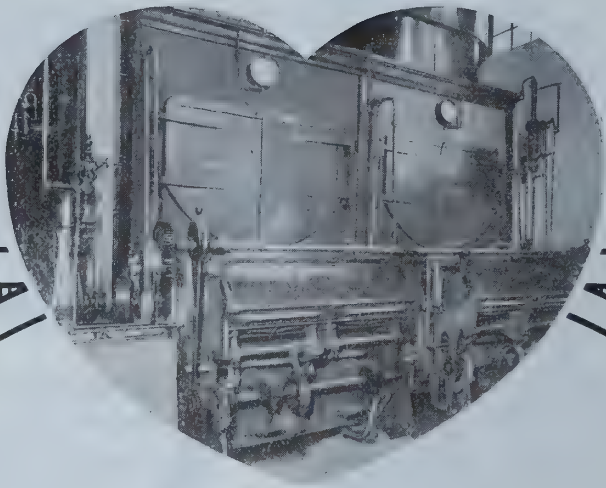
Branch Offices:

Calgary, Alta.	**1001A First St., East**
Montreal, Quebec	**348 St. James St.**
Toronto, Ont.	**77 Adelaide St.**
Winnipeg, Man.	**Galt Building**

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Highest Efficiency

In the Heart of your Plant



is procured and maintained at very small cost through the use of

Potato Scale Boiler Compound

It removes old scale, and a small quantity used daily prevents scale formation, pitting, corrosion, foaming and other boiler troubles due to impurities in the feed water.

It is made to suit feedwater conditions and it contains no ingredients that are injurious to boiler metal or fittings.

Potato Scale Boiler Compound is **saving fuel, boilers and labor**, and keeping boilers at their maximum efficiency FOR THOUSANDS.

Potato Scale Powder is guaranteed to give satisfaction.

C. C. SNOWDON

Refiner, Importer and Manufacturer of

Pennsylvania Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

1810-1840 11th Street E.
Calgary, Alberta, P.O. Box 1384

Branches: Edmonton, Winnipeg, Vancouver

Car Loads and Car Loads of Fuel can be saved annually

by using

Perolin

The Boiler Metal Treatment

(NOT A BOILER COMPOUND)

Perolin merit has placed it in over 30,000 plants in Canada, United States and Mexico, in the last four years.

Its ACTION IS DIFFERENT than that of boiler compounds.

It has no effect whatever upon the feed water, although it is used in a similar way to **feed water** treatments.

The contraction and expansion caused scale to crack. Perolin works through these cracks to the metal and works along the metal, loosening the scale **mechanically**, not chemically, so that it can be readily washed out.

When old scale is thus removed, PEROLIN forms a preservative film over tubes and shell. This film prevents scale-forming substances from adhering to the metal and prevents pitting, corrosion and galvanic action.

The preservative film is an efficient transmitter of heat. It KEEPS THE BOILER UP TO ITS FULL-RATED CAPACITY, and as aresult IT EFFECTS AN ENORMOUS SAVING IN FUEL, BOILER REPAIRS AND UNNECESSARY WORK FOR THE ENGINEER.

We'll ship you, freight prepaid, a sufficient quantity to test for sixty days, no cure—no pay.

GUARANTEE

We guarantee PEROLIN. the Boiler Metal Treatment

1. To loosen scale already formed in the boilers by its mechanical action;
2. To Prevent New scale from forming;
3. To protect the boiler metal against pitting, corrosion and galvanic action, regardless of the kind of water used;
4. To correct troubles caused by oil and grease getting into the boiler water;
5. Not to affect or impart any off-odor to steam or distilled water, or affect in any way the products of breweries, ice plants, dye-works or other industries using live steam for cooking or manufacturing;
6. That PEROLIN is not a boiler compound for water treatment, but operates independent of water conditions;
7. The PEROLIN preservative liquid film is a good heat conductor, adding to the efficiency of the boilers:
8. The establishment of the PEROLIN protective film in new boilers will prevent all scale formation and corrosion, thus keeping the boilers up to their full rated capacity.

Perolin Company of Canada, Limited

76 Adelaide Street West **Toronto, Ontario**

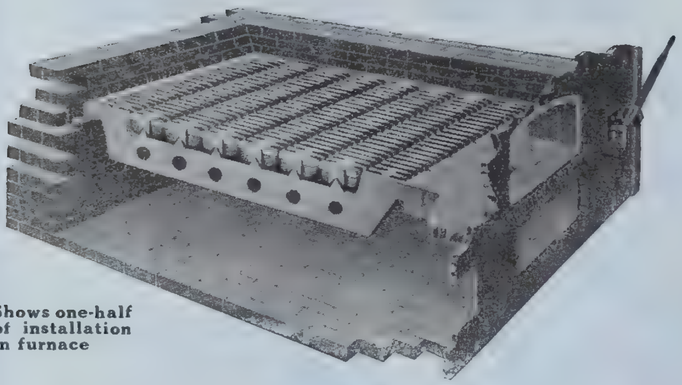
Quebec Agents: Burroughs, Joyce & Co., 30 St. John St., Montreal, Que.

Manitoba and Northern Ontario Agents: Engineering & General Supply Co., Ltd., 206 Nanton Bldg., Winnipeg, Man.

Alberta Agents: The Western Supply & Equipment Co., Ltd., Calgary, Edmonton and Lethbridge, Alta.

British Columbia and Yukon Agents: Bayfield & Archibald, 334 Se[illegible]our St., Vancouver, B.C.

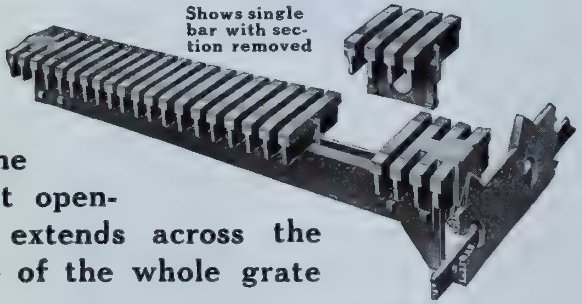
The McNaughton Grate



Shows one-half of installation in furnace

means a saving in fuel, through more efficient combustion, decrease in density of smoke, easier firing and considerable increase in capacity of boilers for overload.

The McNaughton Grate stands up without sagging or buckling, under the most severe test, if given proper care.
REDUCES COST OF UPKEEP FROM 50 to 75% AND ENABLES ONE TO ALWAYS KEEP IT IN FIRST-CLASS CONDITION.
The method of construction makes **repairs easy** and often saves the purchase of an entirely new Bar.
The whole set of Grates and framework is self-contained, and **will fit in where any ordinary grates have been removed.**



Shows single bar with section removed

The draft opening extends across the face of the whole grate

without being closed off or across any place whatever. No other grate could possibly give more draft area and leave any metal to support the fuel. None other can equal it in this respect and not have mechanical disadvantages which only this system of construction entirely overcomes.
There is room for expansion between each section, and no part of the bar is ever under any heat strain.

INSTALLATION ON 30 DAYS' FREE TRIAL. WRITE FOR PARTICULARS.
Ask for Bulletin No. 2

Galt Foundry Company

GALT, ONTARIO

It costs deadly to neglect your Boilers

It does take time and labor to keep boilers free from scale under the "digging out" method.

"Digging out" is no longer necessary, for by placing a small quantity of

Walker's Electric Boiler Compound

in your feed water, the cleaning is done scientifically and with practically no time, labor or cost.

If there is but ONE-EIGHTH inch of scale in your boilers your **fuel waste** ranges from 15 to 25%, and there is more labor for the fireman.

Besides keeping **boilers at full capacity** and fuel bills at a minimum, this boiler compound **prevents pitting, corrosion or other boiler troubles** due to impurities in the feed water.

IT WILL **NOT** INJURE BOILERS, TUBES OR FITTINGS. Nothing enters the composition that is of injurious inclination.

Try a barrel. We guarantee satisfactory results.

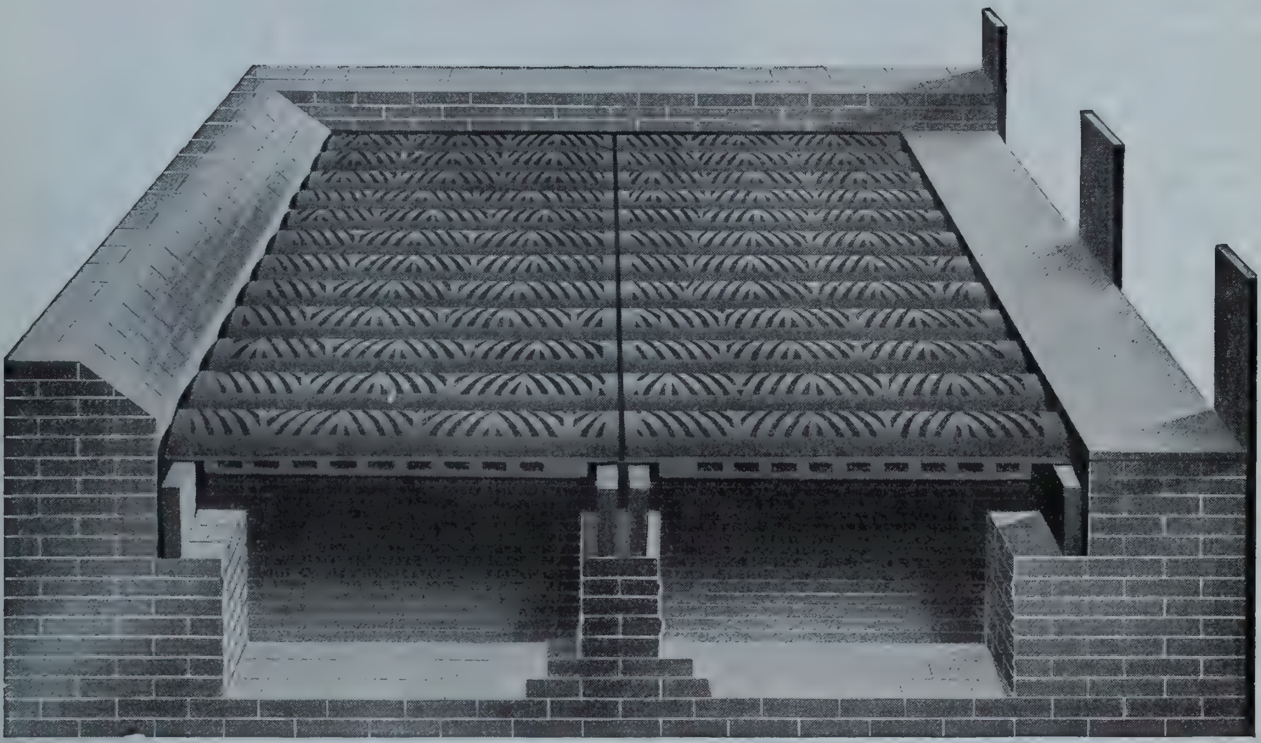
The Electric Boiler Compound Co., Limited

GUELPH, ONT.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

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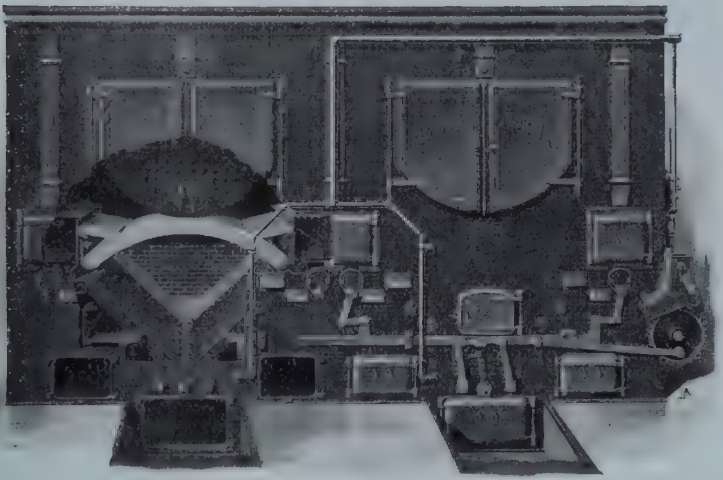

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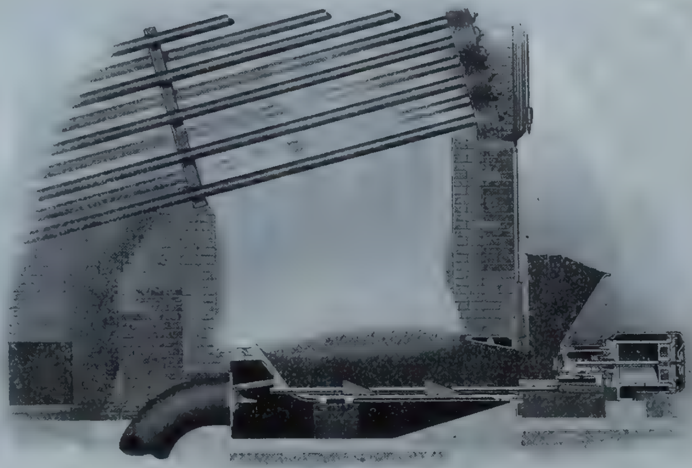

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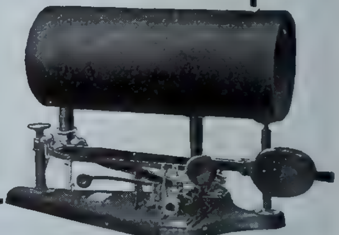

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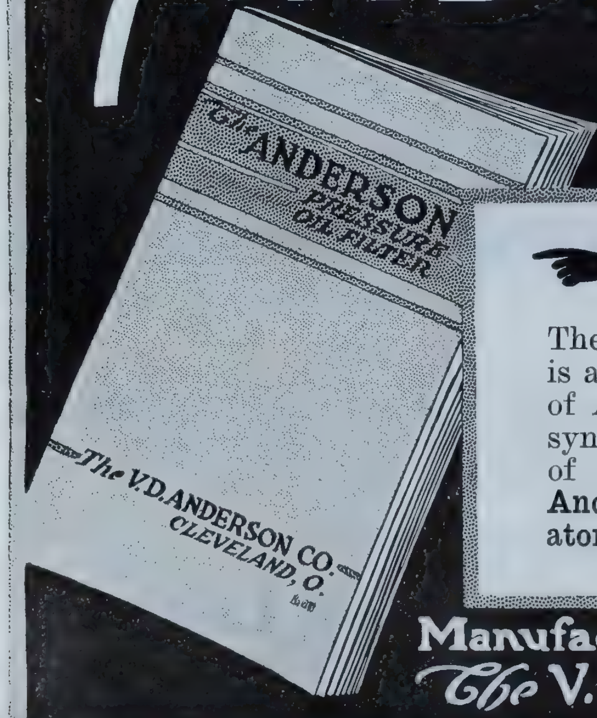

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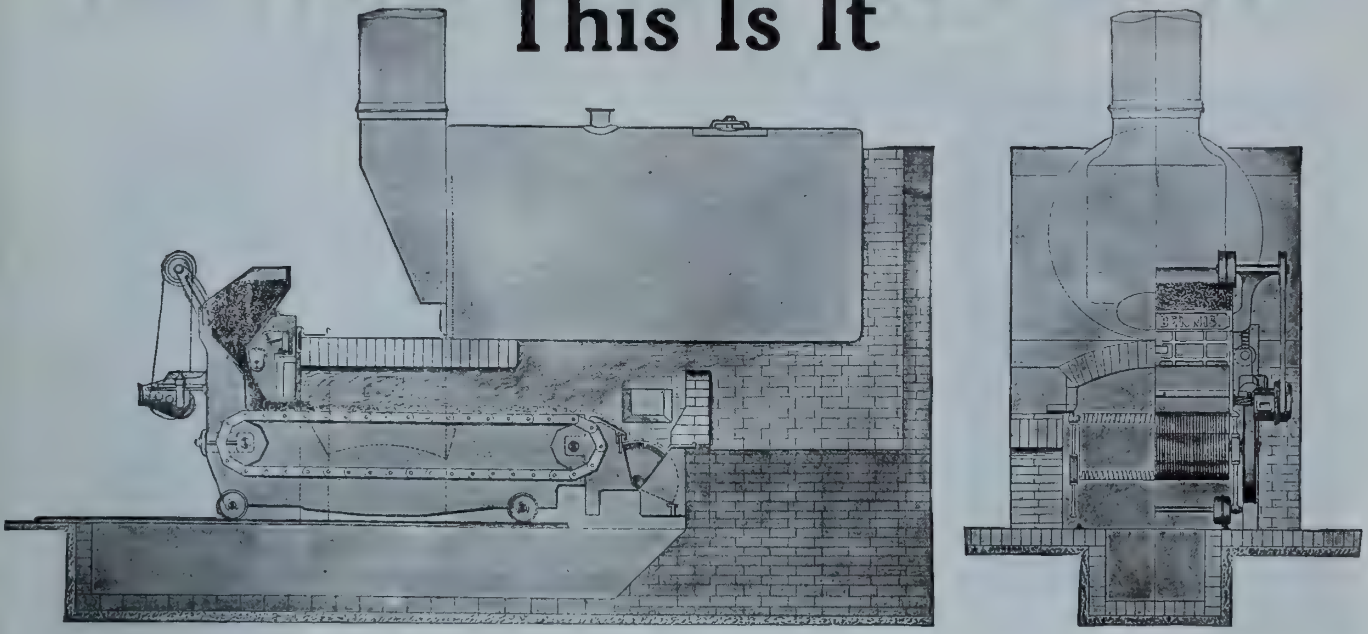

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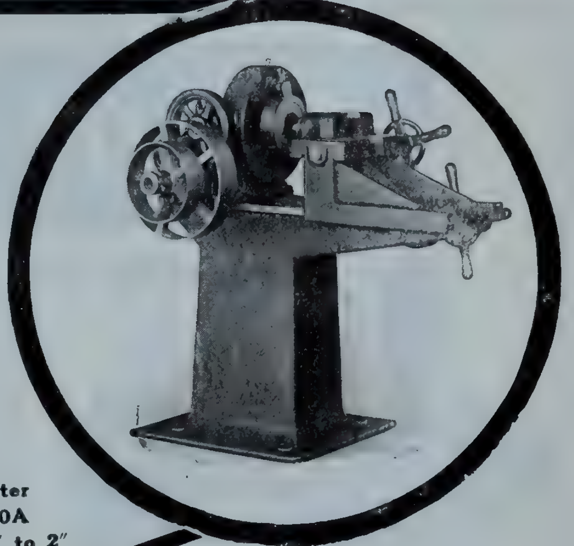

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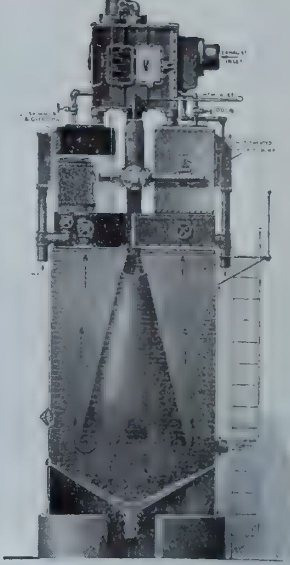

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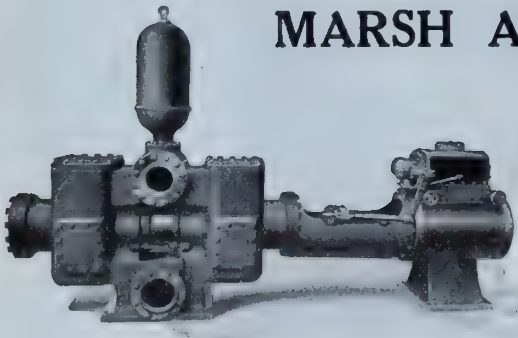

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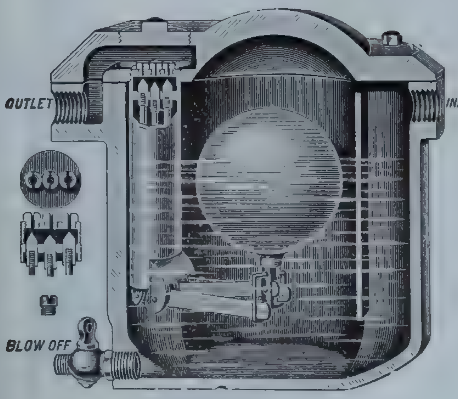

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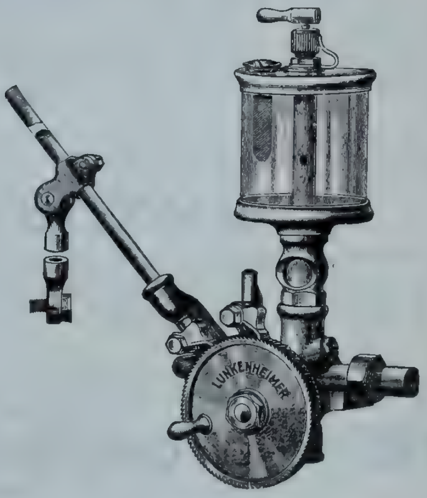

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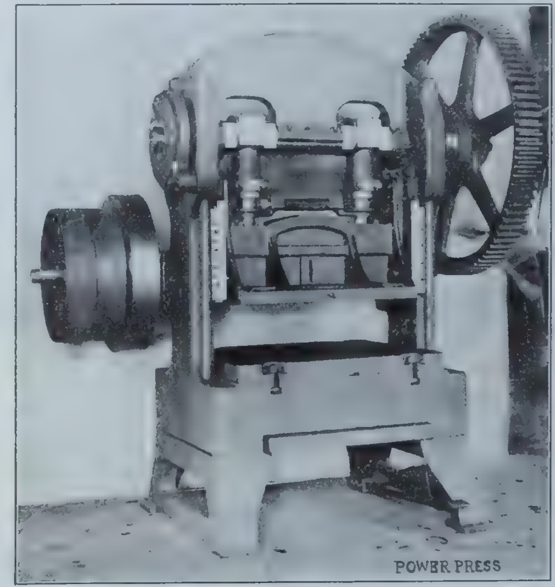

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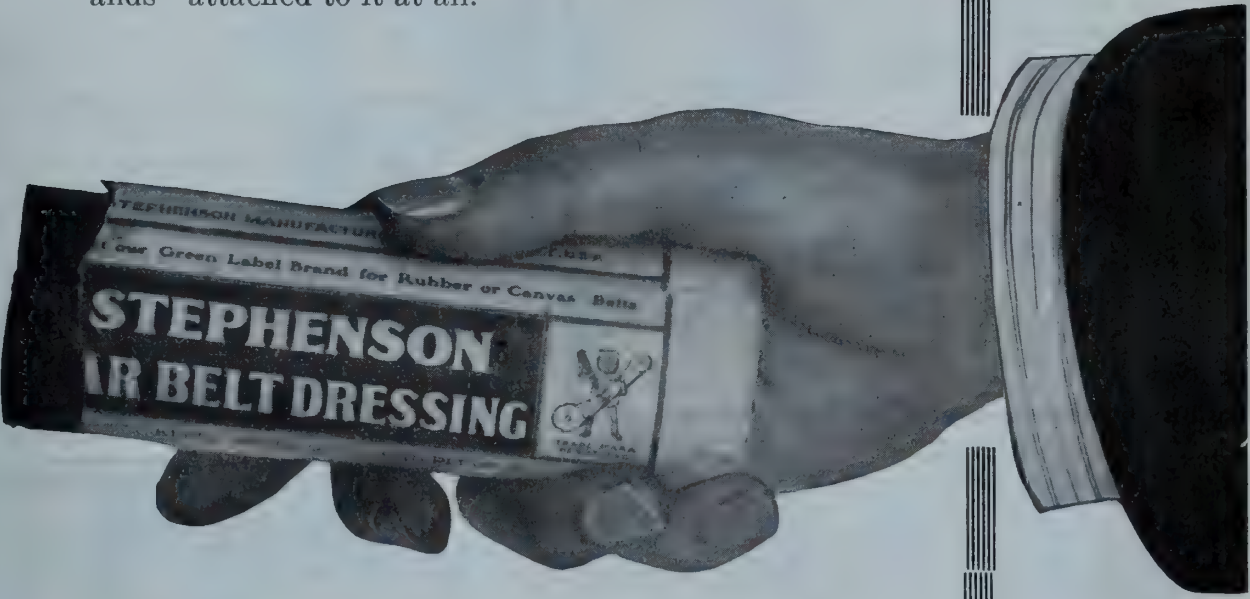

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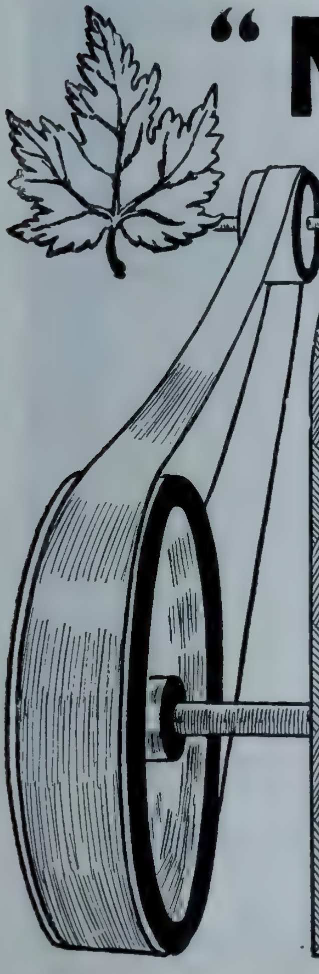

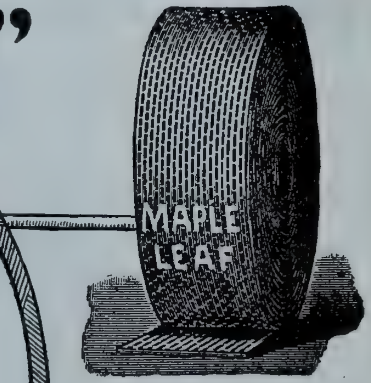

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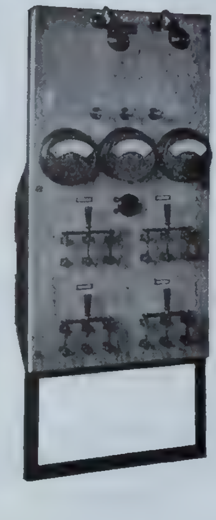

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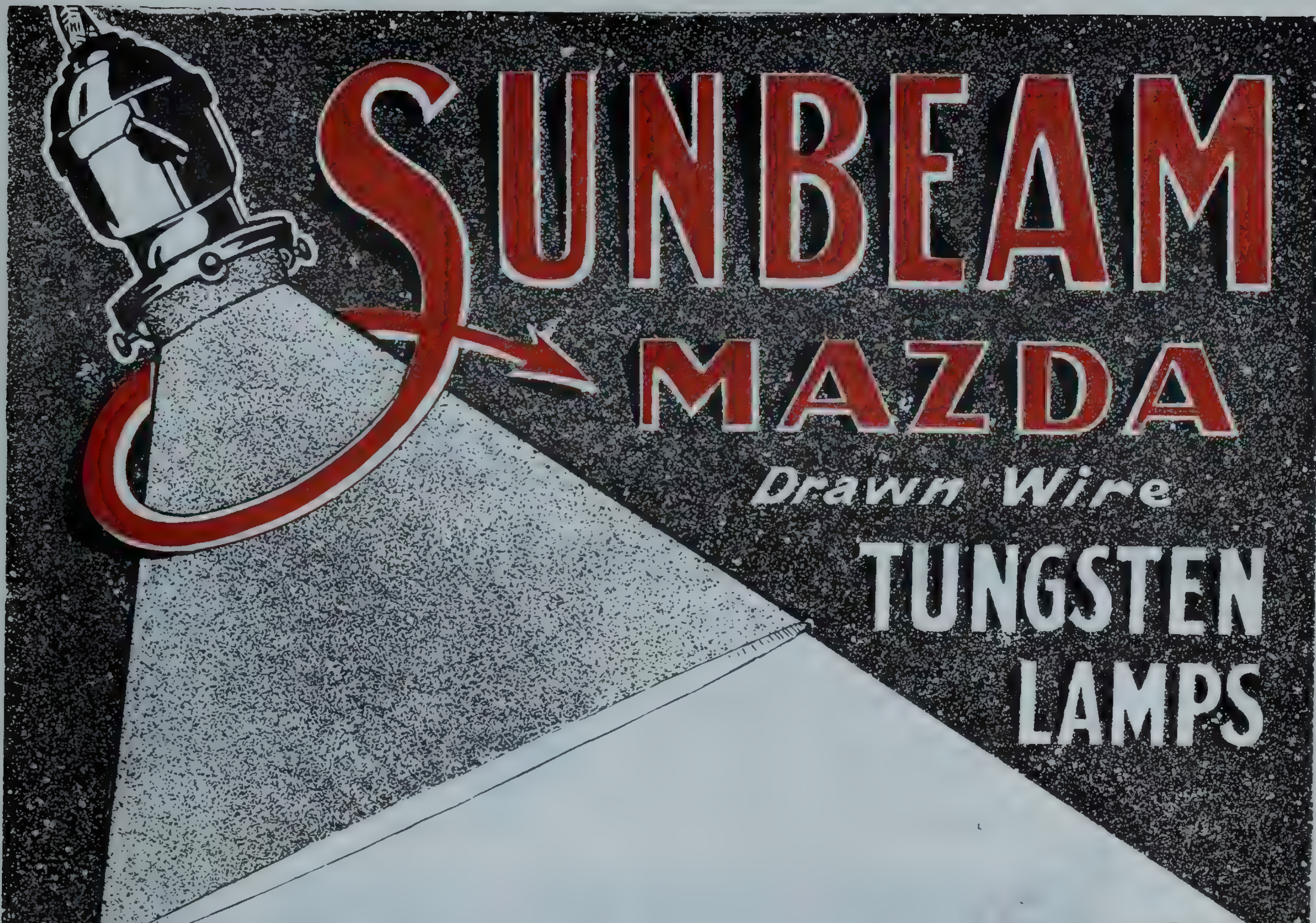

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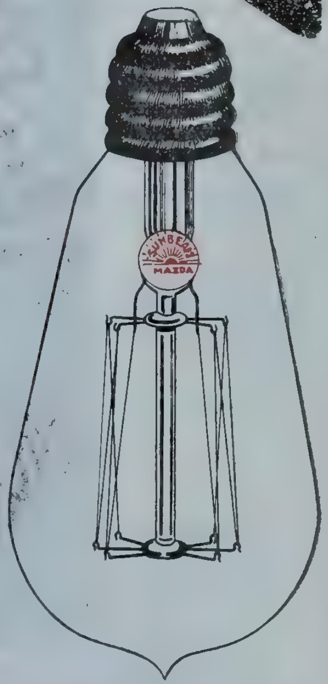

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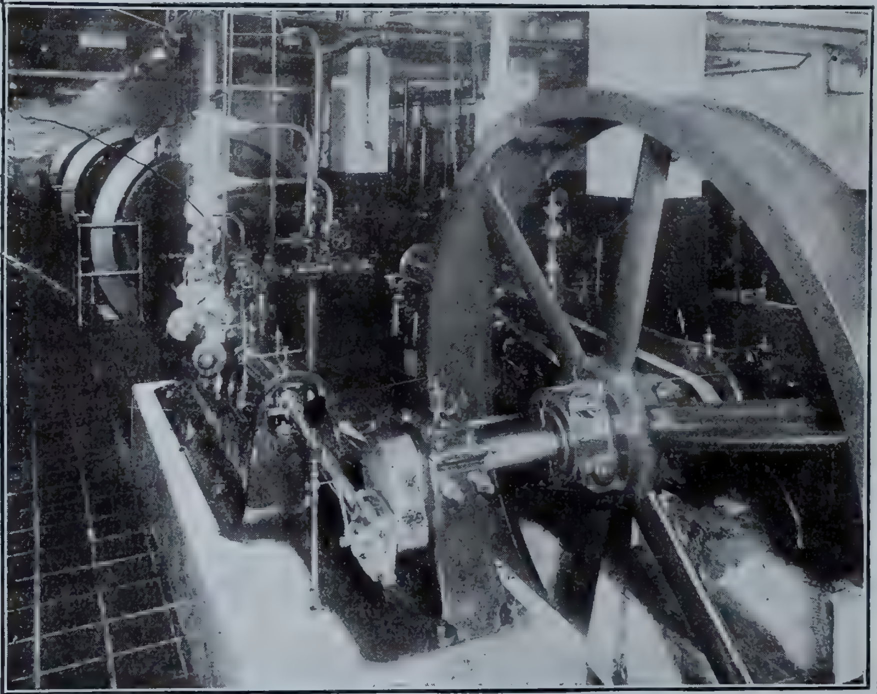

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Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

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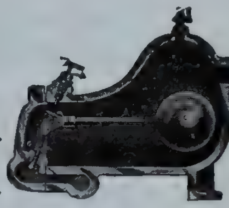

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is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

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DE LA VERGNE REFRIGERATING MACHINERY

is the standard of the world in the field of refrigeration.

De La Vergne machines have been installed in all parts of the world.

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Here is the answer—

When we sold these two H. & C. Safety plants 12 months ago to the Pittmans & Dean Co., we guaranteed them a daily capacity of 75 tons each. We further guaranteed to produce Ice for not more than 55 K.W. per ton.

During the months of July—August—September, of last year—the heavy months—each H. & C. Safety gave an average daily production of 84 9-10 tons,—**9 9-10 tons or 13 1-5% more than our contract called for.**

What is more—we did it at a cost of 48 7-10 K.W. instead of our guarantee of 55 K.W., an economy of 6 3-10 K.W. **per ton or more than 11½% saving in power consumption.**

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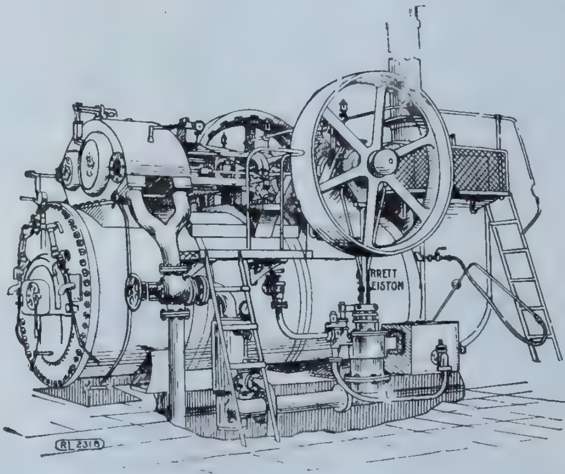

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Can use any kind of fuel
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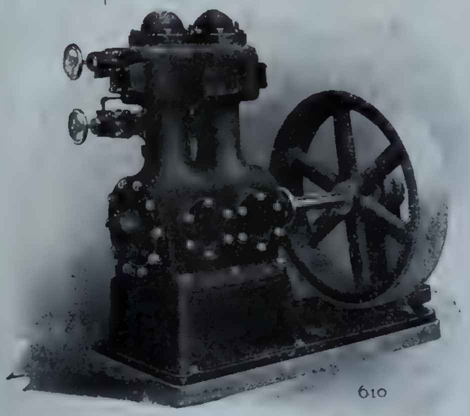

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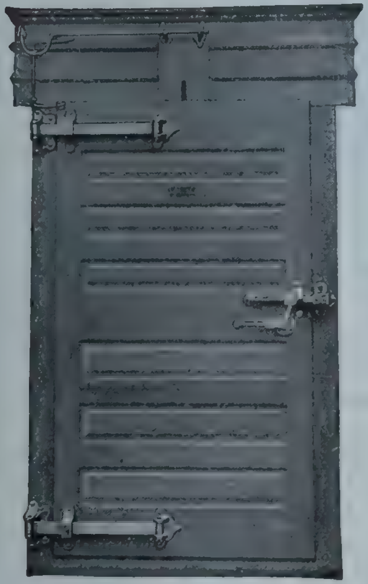

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The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones'." Built for strength and durability.

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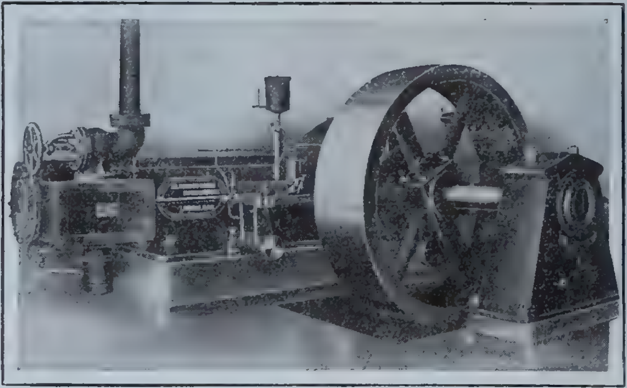

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Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

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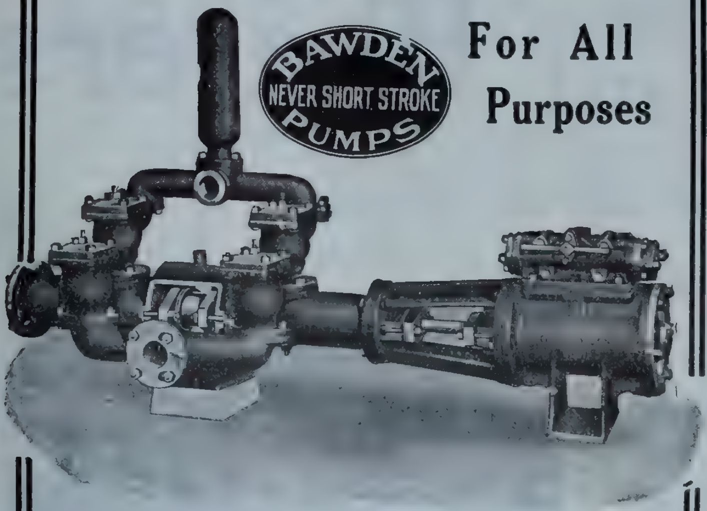

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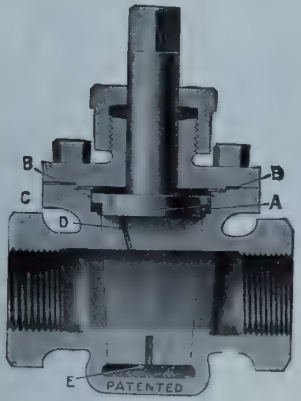

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For Every Purpose

Engineers will tell you that Homestead Valves are the best for all Water, Air or Steam lines. This they have learned by experience

Simple in construction, easy to operate, and the only valve which will successfully stand up under the heaviest duty service.

Made in Straightway, Threeway and Fourway patterns. Special valves for special purposes.

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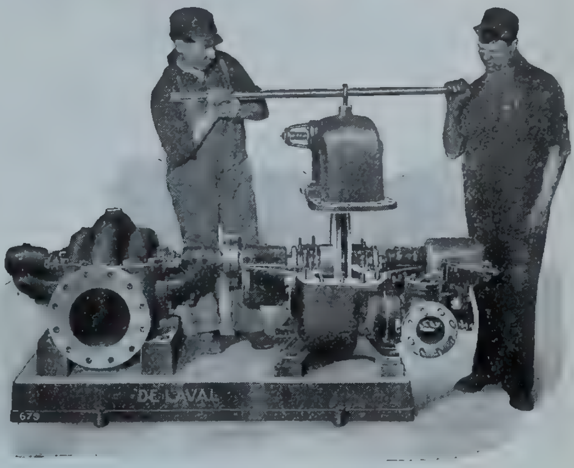
Install a

DE LAVAL

Class "C" Turbine

To Utilize the Exhaust



of your present reciprocating engine, developing from 75 to 100% more power without any increase in boiler capacity or expense.

When more exhaust steam is required than is furnished by the engine, the turbine can be run on live steam exhausting to back-pressure. The plant thus runs continuously at maximum economy.

The De Laval Class "C" Turbine is simple, substantial and easily handled. All moving and working parts are accessible upon lifting the casing cover and without disturbing steam or exhaust connections. All rotating parts can then be lifted out upon lifting the bearing caps. Parts subject to wear are made to limit gauges and are interchangeable.

It is the ideal turbine for driving centrifugal pumps, blowers, small generators, etc., or with a De Laval Reduction Gear, for rope or belt drive, or for driving large fans, ice machines or other moderate or slow speed machinery.

Our new Class "C" Catalog, just issued, contains several chapters on improved methods of using steam turbines for improving the economy, increasing the output and adding to the simplicity and reliability of steam power plants. Specify Catalog "C-61."

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If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Polson Marine and Land Boilers

have that reputation throughout Canada which can only be secured by many years of successful building.

Let us have your Plans and Specifications

ANY SIZE
ANY PRESSURE
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If you want a boiler, tank or any kind of plate work---get a price from

Polson Iron Works, Limited

Steel Ship Builders, Engineers and Boilermakers

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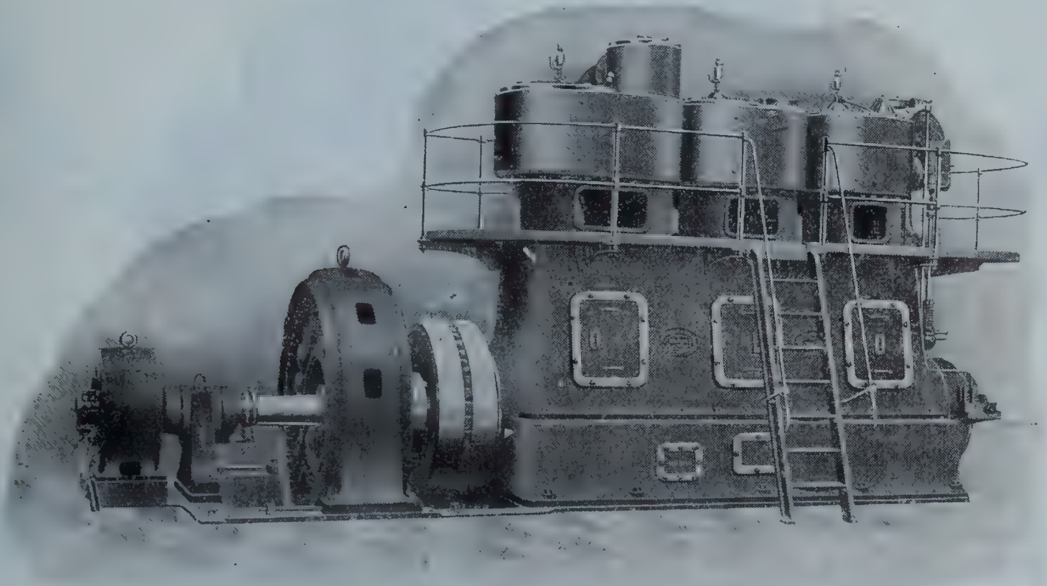
The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Two Installations, 750 Brake Horse Power each; 350 Revolutions; Montreal Water Works.

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Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

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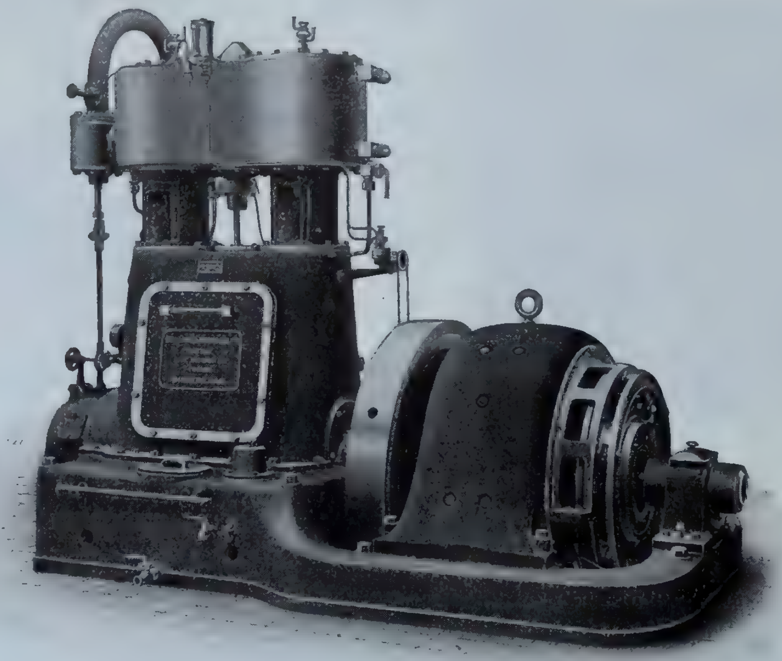

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212 Board of Trade Bldg. **MONTREAL**

SAMSON TURBINE WATER WHEEL

Made in Canada

TESTS AT HOLYOKE, MASS.

(Official Testing Flume)

Give 89.99% Efficiency

From $\frac{3}{4}$ to $\frac{7}{8}$ Gate

These turbines are furnished for vertical and horizontal settings in either single or multiple units.

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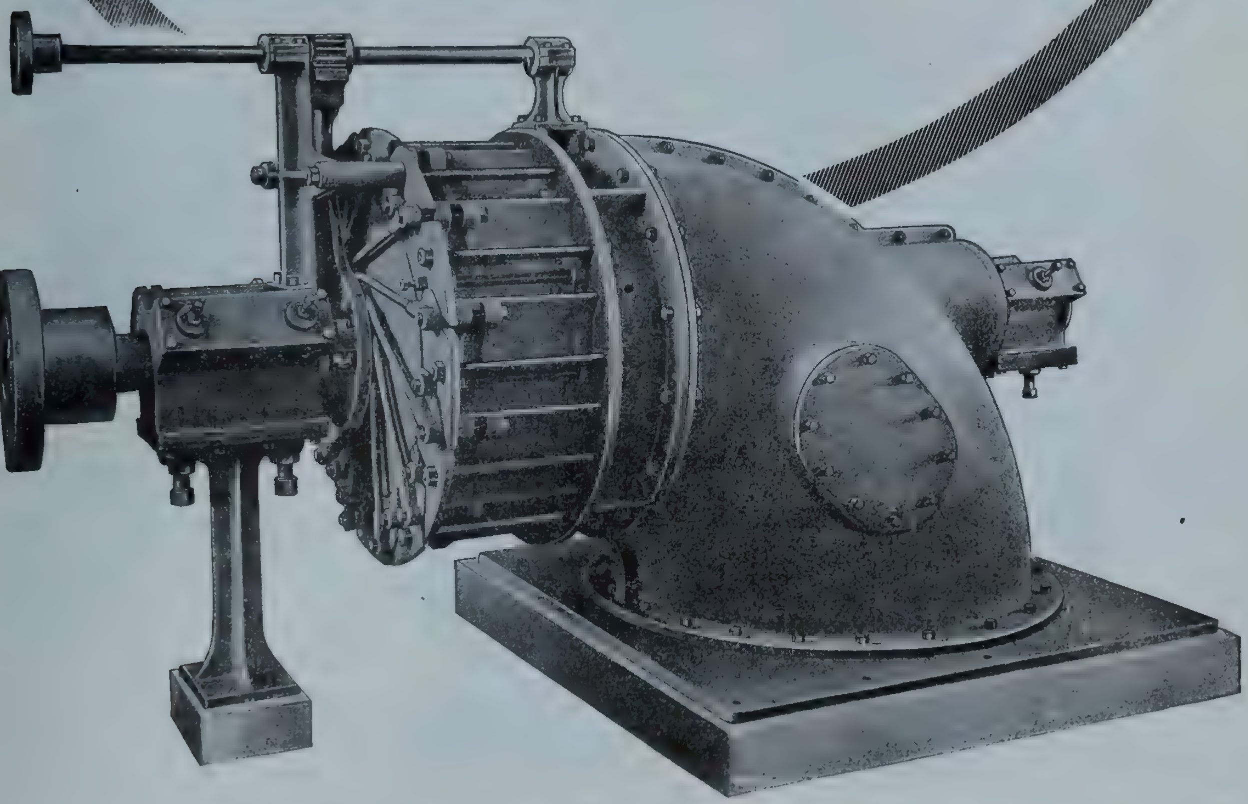
Ask us for catalog. It gives full details.



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GOLDIE & McCULLOCH CO.

SECTIONAL WATER-TUBE BOILERS

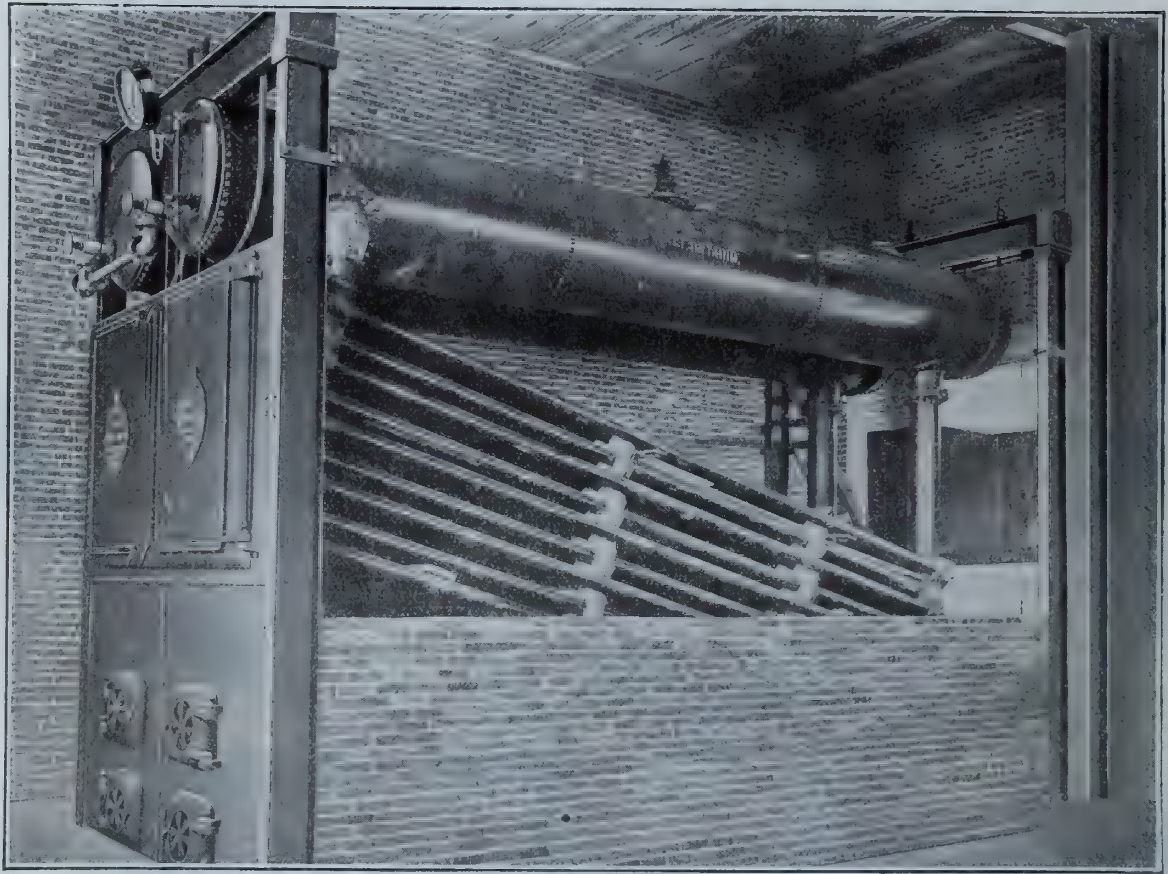

Illustration shows one of our Type A Double Drum, Sectional Water-Tube Boilers being installed at the plant of the Kelsey Wheel Co., Ltd., Windsor, Ont.

Have Positive and Rapid Circulation. Have Enlarged Area for Combustion. Have Steel Staggered Headers of Large Area. Have Increased Steaming Capacity. Have Straight 4-inch Tubes.

Our Bulletin No. 30 Illustrates and Describes the Different Types. ASK FOR A COPY.

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VANCOUVER, B. C.

Power Plant, the C.P.R. Windsor Street Terminal, Montreal

Staff Article

In order to enable the reader to more fully comprehend the extent and capacity of the Canadian Pacific Railroad Co. headquarters, and to thereby get a more intelligent grasp of the light, heat, power, etc., equipment installed in connection therewith, a brief, racy introductory description is given of the general departmental layout.

THE Canadian Pacific Railway Company has been rebuilding its Windsor Street terminal station in Montreal for the past three years and now, with the work almost completed, it is the premier railway station in Canada. In addition to being a railway terminal, it also contains the head offices of the company. The main buildings of massive grey stone blocks are of substantial construction, and with their great height which is still further increased by the huge square tower on the south-east corner, afford a landmark from a radius of many miles around.

Accommodation Features.

The midway or concourse has excellent natural light secured by means of large skylights. In the sheds which are a little over 1,000 ft. long, there are eleven tracks, and on the roof over the centre of each of the latter, ventilators, carry out into the atmosphere all the objectionable smoke and vapors emitted from the locomotives.

The ceilings of the waiting rooms are all high, and the artificial lighting is from incandescent tungsten lamps, mounted on posts in clusters of six, with a larger centre lamp. The lamps are of 100 watt capacity, and are surrounded by spherical shades of white glass. At either end of the general waiting room is situated the ladies' and gentlemen's waiting rooms respectively. The decorations are plain and simple, but as most of the interior finish is of marble, the effect is altogether pleasing.

The dining room and restaurant present a very attractive appearance. The idea of the management is to give the very best of service and food, and to do so at a reasonable charge. Needless to say, the effort is meeting with success.

The baggage room is located to the right, when entering the concourse through the main entrance on the corner of Windsor and Osborne streets.

The offices and executive departments of the company are located in the upper storeys of the building block, while underneath the tracks in the train shed, are to be found the huge vaults in which the vouchers and various records are kept.

The emigration quarters are also located under the tracks and face St. Antoine street. As the ground on which the terminal is built, slopes toward this street, these rooms have natural window light. The Chinese apartments are separate from those of other nationalities because of their being subject to a head tax. Inmates of this section are of course under strict supervision.

The main portion of the building is three storeys high, from which the main tower rises to a height of eleven storeys above the level of the concourse. However, as we go nearer to St. Antoine street, two storeys more are gained by reason of the sloping ground, and those are known as floors A and B. The level of the concourse is approximately that of Windsor street at the intersection of Osborne street. Two huge elevators receive the public at the St. Antoine street entrance and bring them up the two storeys to the level of the concourse. When once in the station, its real beauty and immensity impress and create a desire to see and know further. To get familiar with the more or less hidden mechanisms which contribute to the smooth operation of the various sections, and to more fully comprehend the immensity of this the headquarters of our premier railroad corporation, the power plant must next be visited, for the power units and accessories that supply the energy to this great terminal are rarely to be found either in such quantity and variety under one roof. In addition, their up-to-dateness and high class nature are such as appeal to even the uninitiated.

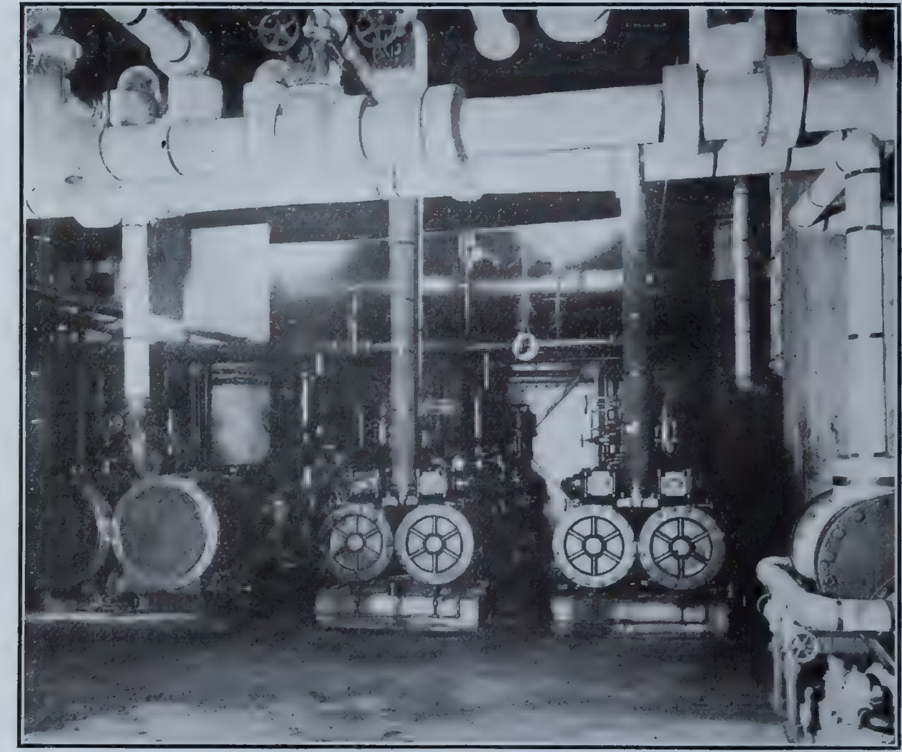
The Boiler Room.

In the boiler room is installed a battery of three 400 horse power Babcock & Wilcox water tube boilers, each equipped with superheaters and containing 144 4-inch tubes of 4,000 sq. ft. heating surface. The grate area is eighty-six square feet, and the boilers are operated under natural draught. The stack is of white brick, and 220 feet high; the inside diameter at top being 12 feet, and the outside diameter 16 feet.

C.P.R. HEADQUARTERS AND TERMINAL, MONTREAL, SHOWING FRONTAGE ON WINDSOR AND ST. ANTOINE STREETS.

The three boilers are equipped with stokers of the chain grate type, manufactured by the Green Engineering Co. of Chicago. Two simple 5 in. x 5 in. steam engines operate the grates. The engines are belt connected to an eccentric shaft, and a ratchet drive is the medium through which the eccentric rods are attached to the grates. The number of teeth per stroke is adjustable. Thus the attendant can soon adjust the speed of his grates so that the required head of steam is maintained under ordinary conditions. The depth of the fire can also be regulated up to a depth of twelve inches. At present steam of 150 lbs. pressure, superheated 150 degrees, is being obtained from a three-inch depth of fire. The superheater is the standard Babcock & Wilcox equipment.

The boilers are equipped with a Mason automatic damper regulator, manufactured by the Mason Regulator Co., of Boston, Mass. The pressure of the steam acts on a piston indirectly, through a hydraulic application, and this acts on the engine through a throttling valve. This regulator also controls the amount of damper opening. This apparatus keeps the steam pressure practically uniform.



THREE WORTHINGTON PUMPS SUPPLYING THE HYDRAULIC ELEVATOR TANKS.

Coal and Ash Handling.

Coal is brought to the power house in standard coal cars and is dumped into huge bins in the bottom of which are hopper-shaped openings. Out of these hoppers the coal is passed through the slide gates into the chutes. The slide gates measure out one-half ton of coal at each operation. The coal passes down the chutes and is delivered to the grates. Ashes are automatically dumped from the fire box into a concrete bin at the rear of the boilers. From this bin, they are raked out through passage-ways into dumping trucks running on a track at the rear. These trucks are run on to an elevator operated by the city water pressure and are raised up to the ash receiving bins where the truck is dumped. The dumping is accomplished by a special lever, being easily handled by one man. The trucks were supplied by the Canadian Fairbanks Morse Co. The ashes go into receiving bins from whence they are loaded through chutes into freight cars to be used for ballasting and filling in on the road construction.

Boiler Feed.

There are two independent Weir boiler feed units, which were supplied through Peacock Bros., Montreal. Each pump is capable of supplying the full boiler capacity. They are of the vertical single cylinder steam driven type. The suction is taken from the feed water heater. Each pump is capable of delivering 5,100 Imperial gallons per hour when making twelve double strokes per minute, against a boiler pressure of two hundred pounds, the feed water temperature being about 210 degs. Fahrenheit. The bore of the steam cylinders is 10½ ins., and that of the pumps 8 ins., the stroke of both being 21 ins.

Accessory Equipment.

A carbon dioxide recorder, by the CO_2 Combustion Recorder Co., of London, England, is fitted to the stack. Adjustments made to the dampers, grate speed, etc., enable soft coal to be burned with almost a total absence of smoke. The safety valves are set to blow a little in advance of 150 pounds. The whole system is controlled automatically, while the attendants and engineers have at all times available, complete information concerning each and every part of the apparatus. The feed water heater is also in the boiler room but as it is so closely connected with the heating system it was thought advisable to describe it under that head.

The Tunnel.

The boiler room is situated at some little distance from the engine room; steam is therefore conveyed to the engines through a tunnel, some seven feet square, for a distance of seven hundred feet. There are four pipes through the tunnel; one of 8 ins. diameter heavily insulated carrying the super-heated steam. A similar pipe runs immediately below it carrying saturated steam to be used in the event of a break down in the super-heating system. A heavily insulated 10 in. pipe carries the exhaust steam back to the feed water heater, and a well insulated 4 in. pipe carries the hot water of condensation back to the feed water heater.

The idea of superheating the steam was to be able to carry it through the tunnel and deliver it to the engines dry and without reduction in pressure.

The Engine Room.

The varied nature of the equipment in the engine room makes it difficult to describe comprehensively. Each machine forms part of its system and must be necessarily described in that connection. Perhaps the first machine to attract attention is the electric reserve unit. All electricity now being used, is obtained from the Montreal Light, Heat & Power Co., and this reserve unit is held only to be used in case of emergency. The generator is a Canadian General Electric unit, 110-220 volt, 75 k.w. single phase, and full load 371 amperes. It is direct connected to a Goldie & McCulloch 14 ins. x 14 ins. "Ideal" engine, equipped with a shaft governor. The exciter which is direct connected to an extension of the armature shaft of the generator is a C. G. E., six pole, compound wound, 125 volt., 7 k.w. machine. The speed of the complete unit is 277 r.p.m.

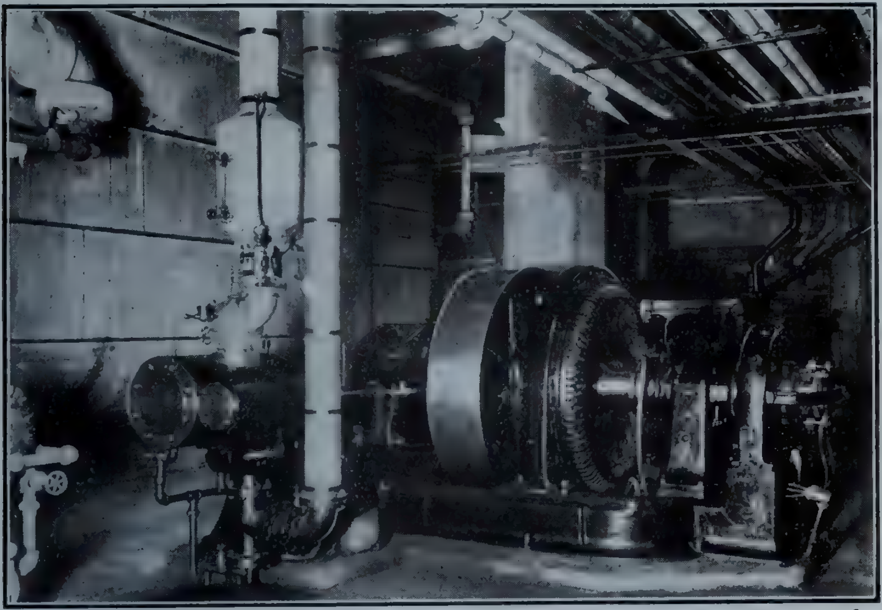
Elevators.

There are thirteen elevators in the building which operate from hydraulic pressure supplied from the pumps in the engine room. The John McDougall Caledonian Iron Works, Montreal, supplied the complete equipment. This includes three sets of Worthington duplex pumps, two of which are of 500 U.S. gallons per minute capacity. They are each double acting, outside packed, and are driven by two sets of tandem compound steam cylinders, of 14 ins. high pressure and

20 ins. low pressure diameters. The diameter of the pump cylinders is 9½ ins., and the stroke is 15 ins. The third pump is larger, having a capacity of one thousand U.S. gallons per minute. Its steam cylinders are 18 ins. and 29 ins. in diameter for the high and low pressure cylinders respectively, while the pump cylinders are 12 ins. diameter and the stroke 18 ins.

Elevator Equipment.

The pumps supply water at 150 pounds pressure per square inch to the tanks for operating the elevators, and are equipped with the Walter hydraulic governor, manufactured by the Walter Governor Co., of Boston, Mass. The water tanks are all air-cushioned to prevent injury from water hammer and to assist in governing the pumps. The air cushion prevents the pumps from ever having to run at an excessively high speed to supply water in the case of a sudden drain on the tanks. The air for the air cushions is supplied by two Marsh, 2 stage, steam driven, air compressors, with 8 ins. bore steam cylinders and air cylinders of 6 ins., and 3 ins. bore. Both compressors are alike, and have a stroke of 8 inches. They supply air at 150 pounds pressure per square inch, and usually receive air from the tank into which the large compressor discharges. This air is compressed to 80 lbs. per square inch, and the little compressors step it up to 150 pounds. They can also be operated independently of the large compressor and then use atmospheric air. The deepest elevator shaft is about two hundred and fifty feet below the surface of the ground.



DIRECT CONNECTED ELECTRIC LIGHTING UNIT. SHOWING DIRECT CONNECTED EXCITER TO THE RIGHT.

The large service pump is a single cylinder vertical and steam driven Weir unit, similar in design to the boiler feed pumps. The steam cylinder is over the pump cylinder and its valve is actuated from a link attached to the piston rod. The steam cylinder is of 16 ins. bore, the pump cylinder of 10 ins. bore, and the common stroke is 21 inches. This pump is capable of delivering 24,300 Imperial gallons per hour against a head of 170 feet when supplied with steam at 100 pounds pressure, and back pressure of 3 pounds. It is capable of maintaining a pressure of 50 pounds per square inch at the fire hydrants when three standard ⅞ in. nozzles are being used. It is a reserve unit for emergency calls.

Compressed Air Units.

The use of compressed air throughout the terminal is rather extensive. The main uses are, however, for charging train lines, testing air brakes and blowing out boiler tubes. There are, of course, many other minor uses but the greatest quantity of air is consumed through the three above mentioned channels. The main compressor is an Ingersoll-Rand machine, single stage, with a simple steam cylinder. The air cylinder is fitted with a tail rod. The steam cylinder is 14 ins. bore, and the air cylinder 12 ins. bore, the common stroke being 18 ins. The machine compresses to 80 pounds per square inch. The air cylinder waterjacket receives its supply from the city mains and although the machine is not of the latest design yet owing to a previous excellent record, it has been still retained for service in the terminal. The two smaller compressors are two-stage Marsh machines used in connection with the air cushioning in the elevator water tanks.

Refrigeration Department.

The refrigeration system caters to a very extensive and important department. There are three ammonia compressors, all of them steam driven, and supplied by the Linde British Refrigerating Co. Of these, two 20-ton units of horizontal design expand the ammonia in a common tank, the brine being used for ice-making. Brine circulation is by means of two 5 in. x 5 in. duplex pumps. The third and smaller unit is of five-ton capacity and of the vertical marine type. The ammonia is expanded in an independent brine tank and this brine is used to cool the drinking water, freeze ice cream and cool the cold storage rooms. The circulating pump is a 4 in. x 4 in. duplex pump. The three circulating pumps were supplied by the Canadian Fairbanks-Morse Co. The steam supplied to these engines passes through a reducing valve and is delivered to them at 100 pounds pressure. With the assistance of the governors this tends to make the operation of the systems quite uniform. The delivery temperature can be easily brought down to 14 degrees Fahrenheit or lower on the very warmest days. There is installed a brine delivery temperature recorder manufactured by the Taylor Instrument Co., of Rochester, N.Y.

Can Ice Making.

The artificial can ice-making plant is capable of freezing 25 tons of ice per day, the latter being used in the dining and lunch rooms and on the dining cars. The brine is used to cool the drinking water. The water first passes through Buhring filters (manufactured by the Buhring Water Purifying Co., of New York City), and is then cooled to 40 degrees. After it leaves the brine tanks, it is pumped to the various tanks by a three-cylinder single acting 4 ins. x 6 ins. Gould pump, manufactured by the Gould Manufacturing Co., of Seneca Falls, N. Y. This pump is gear-connected to a 5 h.p. Wagner Electric Co., 110-220 volt motor. A second similar pump is mounted near this pump but up to the present the demands have not been beyond the capacity of the one pump. The capacity of one pump is 1,000 Imperial gallons per day.

Pipe Coloring Scheme.

The vast quantity of piping in the boiler and engine rooms would render it often very difficult to locate or trace particular lines. Thus, a color scheme has been introduced, and this is followed to a great extent throughout the whole building. A yellow pipe carries live steam; a black pipe, exhaust steam; a blue pipe, hot water; and a red pipe, cold water. The heavy cork insulation on the brine piping is also painted black, as for the exhaust piping, but on account of the lay-out no confusion is caused.

Hot Water Heating.

For hot water heating in wash rooms, low pressure or exhaust steam is passed through coils in two tanks in the engine room, but for heating water used in the wash rooms above the fifth floor, a third smaller tank is employed through the coils of which live steam is passed.

Water Supply Signals.

There are three large tanks in the top of the building which supply water to the lavatories. If these tanks are ever filled too full, and are liable to overflow, a red incandescent lamp in the engine room warns the engineer of the fact. Should, however, the water supply be normal, a white light is kept burning to acquaint him of the fact. A constant record of the pressures of the live and exhaust steam is kept by the continuous recording instruments of the American Steam Gauge & Valve Co., of Boston, Mass.

The Heating System.

The whole heating system is on the vacuum principle. The steam employed is the exhaust of the various engines, and on cold days this is supplemented by boiler steam passed through a reducing valve. The steam passes into the main exhaust header, from which all steam heating lines lead. At night when but few of the engines are running, the heating system depends largely on the boilers for the source of supply.

There are three Burnham pumps, by Darling Bros., Montreal, which extract the water of condensation from the returning steam and pump it through the 4-inch pipe in the tunnel to the 1,500 horse power Cochrane feed water heater. This latter was manufactured by the Harrison Safety Boiler Works, Philadelphia, Pa. The pumps are all of the same size, namely 8 in. x 10 in., with a stroke of 12 inches. They create a vacuum of about ten inches. The exhaust steam passes back through the tunnel and enters the feed water heater. The temperature of the water as it enters the boiler is about 210 degs. Fahrenheit. A Bristol temperature recorder regulates the temperature of the feed water.

Aside from the ordinary steam-heating system there are installed several steam lines to the roofs of the buildings and train sheds, to melt the snow when a sufficient quantity accumulates.

The Ventilating System.

The problem of ventilation was a difficult one, and the very efficient system installed, certainly reflects great credit upon the designers. Several large fans are employed, and all of them have been supplied by the B. F. Sturtevant Co., of Galt, Ont.; and Boston, Mass. They are of the multivane type and arranged so that the air is thoroughly screened as it is taken from the atmosphere. The ventilating system can really be divided into three small systems. In each of these, the air is heated before being washed, and again reheated after washing to 70 degrees Fahrenheit. Of course, in the warm summer months, the heating operations are dispensed with.

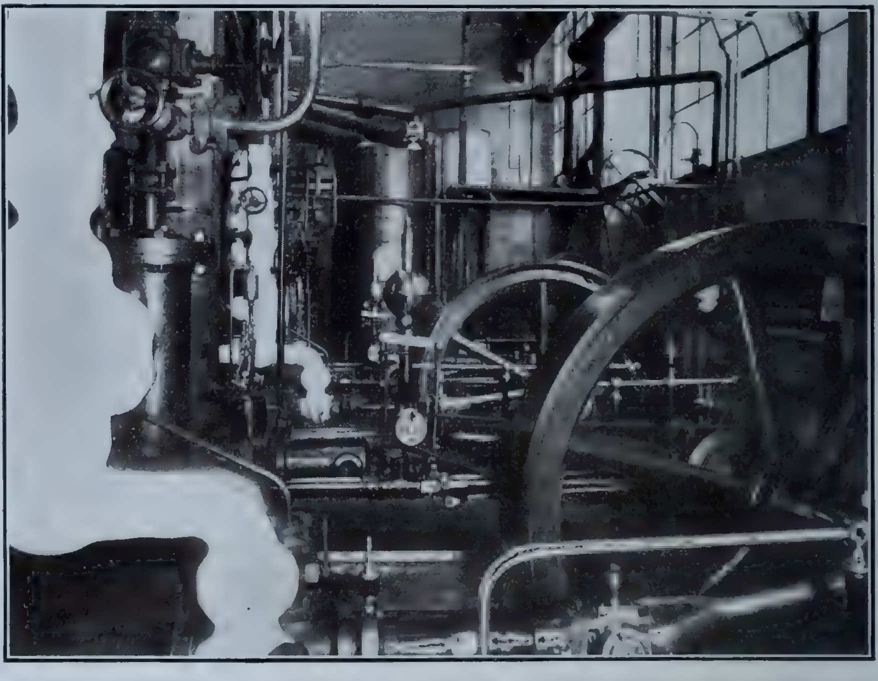
The air, in the largest of these three systems, passes from the atmosphere to the heating steam radiators and on to the washing chamber where it passes through sprays of water. The water is pumped by two centrifugal pumps supplied by Sheldon's, Ltd., Galt, Ont. These pumps are each direct connected to 5 h.p. Wagner Electric Co. motors. From the water sprays, it passes through the second steam radiator set and then on into the fan. This fan is 93¼ inches in diameter by 49 3-16 inches wide, and delivers 102,000 cubic feet of air per minute against a pressure of 1¼ inches of water. It is direct connected to a 10 ins. x 12 ins. Sturtevant engine which runs at 160 r.p.m. This system delivers air to the main floor offices, waiting rooms, dining room and restaurant.

The second system ventilates the offices and corridors on the upper floors. The air washer receives water from a Sheldon centrifugal pump direct connected to a 5 h.p. Wagner motor. The fan is 52½ inches in diameter, by 28⅛ ins. wide and is capable of delivering 31,300 cubic feet of air per minute against a pressure of 1 ins. of water. It is direct connected to a 7 in. x 10 in. Sturtevant engine, which runs at a speed of 200 r.p.m.

The third system supplies air to the vaults and emigrant rooms, and also the Chinese detention rooms. This air washer receives its supply of water from a Sheldon centrifugal pump direct connected to a 5 h.p. Wagner motor. The fan is 72⅞ inches in diameter by 30½ inches wide. It is capable of delivering 42,000 cubic feet of air per minute against a water gauge pressure of 1 inch. The fan is direct connected to a 10 ins. x 10 ins. Robb-Armstrong engine running at 160 r.p.m.

In the Chinese and emigrant quarters, three exhaust fans are located on the ceiling. Two of them are No. 80, steel plate, blower fans, belt connected to 5 h.p. motors, while the third is a 24 in. propeller fan, belt connected to a 2 h.p. motor.

The main exhaust fan is located in the engine room, near the ventilating fans. It is also a Sturtevant product, 58¼ ins. in diameter by 30 15-16 ins. wide, and is capable of delivering 31,500 cubic feet of air per minute against a 1 inch water gauge pressure. It is direct connected to a 6 in. x 6 in. Sturtevant engine running at 270 r.p.m. The air, in cold weather, is delivered at 70 degrees Fahrenheit. The specifications call for the following changes of air and the system has fulfilled the requirements to the satisfaction of the company.



A CORNER OF THE REFRIGERATION SYSTEM.

Toilet rooms every six minutes.

Exterior toilets every eight minutes.

Offices every twelve minutes.

Waiting rooms every twenty-five minutes.

Smoking rooms every twenty minutes.

Dining and lunch rooms every fifteen minutes.

Kitchen every twelve minutes.

The heating and ventilating systems

were installed by James Ballantyne & Co., Montreal.

Electrical Apparatus.

The applications of electricity are many and varied, and numbers of devices involving them are being installed at the present time. Throughout the biluding, clocks are distributed which are controlled electrically by one master clock. This ensures all clocks being always absolutely correct.

One man is enabled by an electrical announcer to inform people in all parts of the station as to the arrivals and departures of trains, and such other information as may be necessary. The announcer merely speaks into a transmitter and his voice is reproduced in various places over the building. This announcing apparatus is placed in all parts of the concourse, waiting rooms, dining room, and restaurant.

The switching and signal tower at the entrance to the yards is able to control the yard entirely by electrical devices. The switches are opened or closed and all the signals manipulated by the proper switches being operated in the little tower. A model plan of the yard is located in the tower, and on this plan a bright electric glow shows the particular section of the track on which a train is standing. Thus the switch man has at all times an accurate and complete knowledge of the progress of all trains in the yard.

Every switch that is thrown, every signal moved, sends back to the tower an automatic confirmation of the event after it has transpired. The system is automatically interlocking and thus guards against the possibility of a collison. Should the source of supply of electricity fail, the tower is not useless. In the basement there is a battery of storage cells which are quite capable of supplying sufficient electricity to run the equipment for two days at least.

To facilitate the handling of baggage several large baggage trucks are equipped with storage batteries and motors. These trucks can receive baggage from a train and quickly have it in the baggage room for delivery. In this way two men can handle a large quantity of baggage very rapidly. These trucks are charged each night.

Summary.

The station taken altogether is an immense structure. To attempt to describe it fully in such a short space would be folly. Only the more important features have been referred to, and these only briefly. Any one having the pleasure to make use of this station cannot help but appreciate its grandeur and magnificence. It is of course not as large as some of the terminals in the United States.

GAS FIRING FOR BOILERS.—II*.

THE introductory article on this subject of gas firing for boilers appeared in our October number, and dealt with the features of early gas firing devices, gas value, gas fired boiler efficiency and gas firing economy requirements. In the present instance the Terbeck burner is featured.

The Terbeck Burner.

Following on these general considerations, the manner in which the Terbeck burner endeavors to accomplish the above mentioned purpose will now be discussed, with a short description of the burner itself. This burner is nothing more than a large, properly dimensioned Bunsen burner. The gas enters the mixing tube through an annular nozzle of accurately calculated and worked sectional area without any important loss of pressure, and draws the primary air in after it, through a centrically-arranged disc valve, an intimate mixture of the gas and air being produced during their passage through the mixing tube. Owing to the possibility of accurately measuring the inflowing gas and air, the most favorable velocity for producing an intimate mixture in the mixing tube can be obtained. The effluent velocity of the gas-air mixture is increased by the taper at the delivery end to such an extent that lighting back is impossible under ordinary working conditions.

Since the whole of the air required for combustion cannot be drawn in by the energy of the inflowing gas, secondary air is admitted—drawn in to some extent by the outflowing gas-air mixture—all round the seat of combustion. The intakes for both gas and air are under control and can be adjusted to a nicety. As the gas pressure fluctuates, the indrawn air is regulated automatically, in so far that, as the pressure increases, the resulting increased energy of flow of the gas draws in a correspondingly larger quantity of air, and vice versa.

The only conditions under which Bunsen burners can give rise to explosions are when the gas is admitted into the boiler without being ignited in good time (in which case the mixture of gas and air which has formed in the flues will explode) or where sudden increases of pressure impart such a high effluent velocity to the gas that the velocity of ignition of the gas-air mixture in the mixing tube is lower than the effluent velocity of the mixture; in which event the flame is naturally disrupted, and the conditions precedent to an explosion are set up. Against the former contingency there is no remedy, so long as one has to rely on workers whose intelligence is a variable quantity. The second possibility can be guarded against by providing in the gas main a safety valve which will blow off when the gas reaches for example 3½ in. gauge, which pressure must of course be taken into consideration in calculating the burner. It is also advisable to set up chequer-work about 6 ft. away from the mouth of the burner. Once it has become red hot, this chequer-work will re-ignite the gas at once should it be momentarily extinguished. These are the only possibilities of explosions being caused by gas-firing devices of any type, and provided the precautions just mentioned be adopted, explosions are quite out of the question.

Operating Efficiency With Terbeck Burners.

Reverting to the subject of the working efficiency of gas-fired boilers this will be discussed with sole reference to the Terbeck burner; and in place of giving merely the data obtained by personal experience, the author prefers to cite certain expressions of opinion by a number of gentlemen concerned in the iron industry. In 1911, Hoff reported on a trial with one of the first installations of a Terbeck burner, built direct in the flue of a boiler and gave the efficiency at 65 per cent.

Last year, Ortmann gave particulars of further trials, in which the volume of gas consumed was accurately measured by means of a gasometer, and which gave efficiencies of 74.9 and 80.2 per cent. with coke-oven gas. The amount of steam generated per cubic foot was 0.24 lb. and 0.28 lb. respectively. Three further trials, with blast-furnace gas in an ordinary flue boiler, gave efficiencies of 76.8, 78.4 and 82.7 per cent., so that a mean efficiency of 78 to 80 per cent. can be counted on. One cubic foot of gas evaporated 0.074 lb. of water, and the amount of CO_2 theoretically possible in the products of combustion for perfect combination without excess of air was 25 per cent.; corresponding approximately to the 10 per cent. excess of air calculated for in designing the burner.

Huessener reported on an evaporation trial extending over a period of 288 hours and giving an efficiency of 82 per cent., each cubic foot of blast-furnace gas producing 0.082 lb. of steam. This experimenter stated inter alia, that when perfect combustion is attained with a minimum excess of air, a relatively low final temperature of the flue gases can be attained by setting the damper properly; and that he himself had seen, at a large German ironworks using the Terbeck burner, the temperature of the effluent flue gases reduced from 300 degrees C to 220 degrees C. in a quarter

(Continued on page 396.)

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*From Iron and Coal Trades Review.

The Design and Service Application of Ball Bearings*

By C. H. Miller

The secret of the great advance in the direction of successful application of ball-bearings to a multitude of services a few years ago considered altogether impossible of attainment lies in the self-aligning feature, the capability of taking end thrust and the installation of two rows of balls instead of one.

THE application of ball bearings to all classes of machinery calls for the serious consideration of every engineer, not altogether on account of the saving of power effected, but as a means by which the weight and overall dimensions of machines can be considerably reduced, especially where internal bearings are necessary. Designs can be made neater, thus reducing pattern work and machining, but more important still, the speed of manufacture itself can be very much increased, which means a considerable reduction in the total cost.

It is therefore necessary to look at this subject in a practical manner, as this is the only side of the question which is of any commercial value to the average engineer. To do this it is necessary to briefly refer to the earlier designs, to point out their weaknesses and to compare, from a practical point of view, the advantages and disadvantages of modern designs for the purpose only of finding the true value of all, so that, when considering ball bearings for any particular application, these remarks may be of value in determining the best design of ball bearings for the purpose under consideration.

Power Saving Feature.

It is hardly necessary to mention the saving of power effected by fitting ball bearings as compared with those of any other type; it will be necessary to state that the total loss of power through friction with ordinary bearings may, at a conservative estimate, be taken at from 10 per cent. to 30 per cent. of the total power applied, in fact in many cases it amounts to 30, 40 and even 50 per cent, but when ball bearings are installed this loss is reduced by 75 to 90 per cent. Taking the total loss of power with plain bearings at the low estimate of 18 per cent., and the saving effected by ball bearings at 75 per cent. of this amount, we get a saving of 13.5 per cent., or a total frictional loss of 4.5 per cent. only. In cases where machines are constantly stopped and started, the saving of power is enormous, as the starting effort with ball bearings is practically the same as the running friction.

Early Ball Bearing Types.

The type of ball bearing, known as the cone type, is one of the earliest forms, and is still used extensively for light radial and thrust duties, owing to the small cost at which it can be manufactured. The only point to be noted in favor of this type is that it has a two-point contact. Professor Stribeck proved beyond doubt that in a ball bearing the ball should only have a two-point contact, and M. Renouf proved the same thing.

In all ball bearings in which the balls touch the races at more than one point only, spinning of the balls takes place. Professor Stribeck and M. Renouf went deeply into the ill-effects of the so-called spinning of the balls, and its ill effects are more pronounced in large bearings than in small sizes. The spinning also causes ball bearings to run hot. Spinning of the balls is not always the fault of the design, being often caused through dirt and grit getting into the bearing.

The shapes and modifications of the cone type ball bearings are innumerable, the principle defect being their adjustable feature, because the slightest turn with a spanner may enormously overload the bearing, or, on the other hand, the bearing may be adjusted too loosely, so that the balls will rattle and the result consequently be unsatisfactory. The prevalent idea that angular ball bearings can be adjusted to compensate for wear is erroneous. Besides, the races can never be made to adjust themselves truly parallel within anything like the degrees of accuracy of the balls themselves and, therefore, when adjusted as nearly perfect as possible, there must be one place where the balls are tighter than another, which means more wear in that particular place and, when adjusted again, the races will become tight in another position, and thus the balls become sealed and the whole bearing destroyed.

In the types of bearings known as "crammed," the balls are not separated by a ball cage, but revolve against each other.

Ball bearings having perfectly flat races are most efficient under test, but are not capable of carrying such heavy loads as the grooved races type. The modern type of ball bearing for radial duty is perfectly adjusted by the makers and therefore this very great advance in design has made it possible to fit ball bearings to every class of machinery, and for any duty without fear of overloading through bad adjustment. A properly designed ball bearing which is not overloaded will not wear and provision for adjustment is not only impracticable, but unnecessary.

Radial Type Ball Bearings.

There are only two types of radial ball bearings having standard overall dimensions—namely, the common single-row type, known as the single-row rigid radial bearing, and the Skefko S.K.F. self-aligning double-row type. Other types are not interchangeable with the common standard overall dimensions.

It will be noticed that there is one great difficulty in the manufacture of the first type, namely, filling in the balls. There are many ways of doing this. Each race must be in one piece, otherwise the hardened steel balls will cause the spliced hardened surface of the race to become chipped, which, of course, spells failure of the bearing.

It has been proved by Professors Stribeck and Goodman that a radial bearing having both races grooved will carry a considerably greater load than one with both its faces flat. When a ball bearing is under load, the balls are slightly flattened, and if the balls are rolling between two flat races the contact area on the balls is a circle; but, if the balls are running in a grooved race, the area of contact is then an ellipse of which the minor axis is equal to the diameter of the circle for an equal deformation of the ball. The area of the ellipse is greater than that of the circle, and the load-carrying capacity is therefore increased.

Now, in radial ball bearings, the races are curved in both directions, the inner being concave in one direction and the outer convex in the other. It is therefore obvious that, in an ordinary single-row bearing where the groove is similar in both races, the area of contact between the ball and the outer race will be greater than between the ball and the inner race. The effect of this is that in practice where wear takes place, it is always more marked in the inner race than in the outer. In the Skefko bearing, the outer race has been flattened out and care taken to avoid reducing the area of contact between it and the ball below, as compared with the area between the ball and the inner race.

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*From a paper read before the Birmingham Association of Mechanical Engineers.

From this it will be seen that the strength of the bearing due to the curvature of the outer race has not been in any way reduced; at the same time this design enables two rows of balls to be used, and in most cases a larger number of balls to be got into each row, so that there are twice as many balls carrying the load. The importance of this increased number of balls is appreciated when it is remembered that the carrying capacity of any radial bearing is directly proportional to the number of balls, if their size be the same in both bearings.

Ball Cage Feature.

There are three main objects for the use of a ball cage. Firstly, because it is impossible to so proportion races and balls, even of the full ball type bearing, that the latter exactly fit the circumference; secondly, to reduce noise; thirdly, to prevent wear.

If a full type bearing be set in motion under the usual vertical load, whenever a ball passes from the region of pressure it is snapped forward, striking forcibly the adjacent ball, causing considerable vibration, and before it comes to rest it is struck by the following ball, which in turn is subjected in turn to the same treatment. This, the chief cause of noise in ball bearings of this type, tends to get worse and worse. The second trouble that the cage overcomes is the wear of one ball on another. With the full type bearings it is not uncommon to find the balls having a groove worn around their circumference, with a radius of curvature equal to that of the ball diameter. One cause of this is deflection. It is most important to keep all ball bearings properly aligned.

Ball cages were devised to keep the balls equally separated in the partly-filled type bearing. To reduce noise and to prevent certain forms of ball wear, a properly designed ball cage should be such that every ball is free in its own setting. It should be strong, if possible in one piece, elastic, and capable of retaining the maximum number of balls in the bearing. Thrust bearings, both of the single and double types, having flat races, should only be used for light loads on account of the difficulty in mounting.

Ball Thrust Bearings.

The stationary race or races and the revolving race must be mounted absolutely parallel with each other and, generally speaking, this is almost impossible, but even if parallelism were possible it cannot be maintained under the deflections due to the load, and it must also be remembered that initial errors or deflections of a thousandth part of an inch will cause the balls on one side to carry the entire load and therefore the margin of safety must be a big one when this type of bearing is used. It is therefore advisable to use a thrust bearing, having a self-aligning race. The race being ground spherical and mounted on a corresponding seating can adjust itself in such a way as to distribute the load equally over the entire number of balls in the bearing, thus making it impossible to overload any one ball. This self-aligning principle, both in radial bearings having large diameter balls ly the secret to the successful application of ball bearings.

Thrust bearings of light and medium types should not be run at speeds higher than 2,000 r.p.m., and heavy type thrust bearings having large diameter balls should not be used for speeds higher than 500 r.p.m. owing to the centrifugal force acting on the balls. Thrust-bearing cages like those used in radial bearings, are in great variety. Those of the pressed type are worthy of particular note. They are made in one piece, and so designed as to take up any centrifugal action on the balls, thus keeping them in the centre of their races. This prevents excessive slipping and spinning of balls, which causes heating and failure of the bearing when running at high speed.

The "Skefko" radial bearing makes a most efficient thrust bearing for light loads at high speeds, but the amount must not exceed 25 per cent. of their radial load given for medium type bearings. The use of this bearing for light thrust loads running at very high speeds entirely overcomes the trouble caused by centrifugal force; they have been successfully used for speeds up to 30,000 r.p.m. This special feature of the "Skefko" radial bearing to take a considerable end thrust without overloading the balls is due to the inclination of the tangent to the curve of the outer race at the point of contact with the ball.

Radial bearings are capable of taking as much as 35 and 40 per cent. thrust duty, and this is a very important feature, as it is difficult to find a position on any machine where radial duty is not combined with a certain percentage of thrust duty. The more conical this type of bearing, the greater the safe thrust load will be in proportion to the radial load. Purely radial bearings—that is, those of the rigid type—are not calculated to resist any thrust load whatever, and when subjected to axial thrust, the makers rightly refuse to accept responsibility for failures.

With the rigid type of ball bearing, it is essential that extreme accuracy be observed in the alignment of the shaft and housing to which the bearings are to be fitted. Therefore, with this type of bearing it is necessary to fit a thrust bearing as well, which not only increases the cost, but also the difficulty of mounting satisfactory. In the self-aligning type of radial bearings, the necessity for this extreme accuracy is obviated, as owing to their construction they adjust themselves instantly and automatically through the rolling of the balls across the spherical face of the outer race to any deflection, thus ensuring equal distribution of the load over both rows of balls. When fitting a bearing of this description for radial as well as thrust duty, all that is necessary is to fix both races of one bearing axially, the inner race on the shaft and the outer race in its housing. Never more than one radial bearing on each independent shaft should be thus fixed; the other bearing or bearings must be allowed free axial movement in both directions in their housings or on their shaft.

Materials and Manufacture.

One of the most important points to consider in the manufacture of a ball bearing is the material used. The best ball bearings are made from the very best Swedish chrome cast steel obtainable. This steel is noted for its hardness, toughness, and high elastic limits. After the races have been turned to shape they are hardened throughout and carefully tempered. The greatest care must be exercised in this process, the exact degree of hardness having been decided after years of experience and tests. The temperature of each furnace should be automatically recorded once every minute, so that the works manager can at any time see exactly what the temperature was in any furnace at any time.

There are still some makers who use a low carbon steel and case-harden the surfaces. The main trouble with a case-hardened bearing is that the thin hard skin tends to flake away from the soft backing which results in the bearing becoming a total wreck, and it must be remembered the greater the area of ball race, the greater the thickness of soft backing, besides which, it is impossible when manufacturing large quantities to obtain a case-hardened surface of equal thickness. It is more difficult to manufacture ball bearings of hardened steel throughout, especially in the larger sizes, where the races are comparatively thin, owing to their tendency to warp during the hardening process. This means that a large amount must be left for grinding, which considerably increases the cost of manufacture, but such bearings are undoubtedly capable of standing a much greater duty than if made of a case-hardened material.

The instruments used for testing the hardness of ball-bearing races are the Scleroscope and the Brinell machines. The Scleroscope measures the hardness of a material by the height of the rebound of a small hammer falling from a definite height. This hammer has a diamond point and actually dents the material, so that its kinetic energy at the moment of striking is partly returned to the hammer as kinetic energy which raises it to a certain height in the glass tube, which is provided with a scale. The Brinell test is to force a hard steel ball of standard diameter into the material under test with a standard load, and then measure the diameter of the impression made. The Brinell test is the more accurate as being practically the same set of conditions as exist in the bearing in practice.

Lubrication.

The question whether a ball bearing requires lubrication has been much debated, but it has been proved conclusively that the friction of a properly designed ball bearing, when it is oiled, is never less and is sometimes greater than when it runs dry. Being made from extremely hard steel and highly polished, they are very liable to rust, and a ball bearing should never be run in a rusty condition, or else failure is inevitable. In actual practice it is found necessary to either pack the housing with a suitable grease for speeds up to about 1,000 r.p.m. or run them in an oil bath for higher speeds. The installation of ball bearings effects a saving of at least 90 per cent. of the lubrication required with plain bearings.

Generally speaking, the users of ball bearings endeavor to fit them accurately. Such great care is not needed, the main object being that under no conditions must the bearings be subjected to strains other than their legitimate duty, and every care must be exercised not to deform the ball races in any way. Parallel bearings should be fitted on the shaft with a light tapping fit, and held securely against a shoulder by means of a nut. A suitable shaft shoulder will be obtained if it is made 1.1 times the diameter of shaft, plus 5-32 in. The outer race should, of course, never be hammered when mounting a bearing on the shaft, a piece of hard wood held against the inner race and tapped gently being all that is necessary.

Ball bearings are now being universally used for line shafting purposes, in which case an adapter sleeve is used between the bearing and the shaft for fitting. One bearing only on each independent line of shafting must be fixed axially, for the purpose of keeping the shaft running in line, and the others free axially in their housings. Thrust bearings or collars are never needed on line shafting when Skefko bearings are fitted. Regarding the race which is made a sliding fit in its housing, many people try to fix them from revolving; this is a great mistake. It is good for this race to creep a little in its housing, as it distributes the load evenly all round the outer race, at the same time the amount of creep is so small that no appreciable wear takes place.

Ball Bearing Housings.

Referring to the design of housings for ball bearings, it is preferable to make them of the split type, and not all in one piece with an end cap, the principal advantages of the first type being that the bearings can be fitted more easily, and the shaft complete with all its mountings can be lifted into the lower part of the pedestal. With the other type, the mounting of the bearings has to be done more or less in the dark, and any slight errors in machining may put excessive end thrust on the bearings, which will probably be ruined before the cause is found out. Housings should be made as large as convenient, and every care should be taken to provide good protection for keeping the bearings free from dust and moisture.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

When special machines are to be fitted on ball bearings it is advisable to submit the designs, together with full particulars of the duty, to the ball-bearing makers, when they will suggest the best type and size of bearing for the duty and show same correctly mounted.

One of the most important points for both the designers and users of machinery fitted with ball bearings is to provide and use every care to keep the bearings clean. The result of dirt and grit in a ball bearing means short life; the particles, no matter how small, collect together and cause spinning of the balls. The balls also tend to mount these particles, with the result that either the races themselves burst or the balls become overloaded, but the usual effect is that the balls become scaled on their one hemisphere and the races worn in deep tracks. The ball cages also often fail owing to the skidding of the balls.

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GAS FIRING FOR BOILERS.

(Continued from page 393.)

of an hour by simply lowering the damper.

In the trial in question the temperature of the effluent gases ranged between 150 and 170 degrees Co., and the percentage of CO_2 was about 15 per cent., the theoretical maximum value being 19.3 per cent. It may be mentioned that the CO_2 was determined in front of the damper where a large excess of air was present, owing to leaks in the brickwork whereas, in order to obtain a proper idea of the operation of the burner, as such, it is necessary for the readings to be taken at a place where errors caused by a defective condition of the boiler are impossible—that is to say, at the end of the flue, in the case of flue boilers, or behind the first nest of tubes in water-tube boilers.

Huessener has personally informed the author that the burner was not touched during the whole 288 hours occupied by the trial. It is true, however, that provision was made for ensuring uniform gas pressure, by installing a special fan; and such a precaution is advisable where the gas pressure is liable to considerable fluctuation or to fall below the normal. In the case of high fluctuating gas pressure, it is a good plan to employ a pressure regulator (such as the Kress), which measure was also recommended by Ortmann.

It should also be pointed out that these results can be obtained without pre-heating and, that if the firing be properly managed, the temperature of the effluent flue gases is so low that pre-heaters of the ordinary type are hardly profitable to install. A great service would be rendered by anyone who could devise a pre-heater enabling the gas temperature to be reduced to below 100 degrees C., before passing into the stack, since such an apparatus would utilize a large portion of the heat of evaporation of the water constituting an important percentage of the products of combustion.

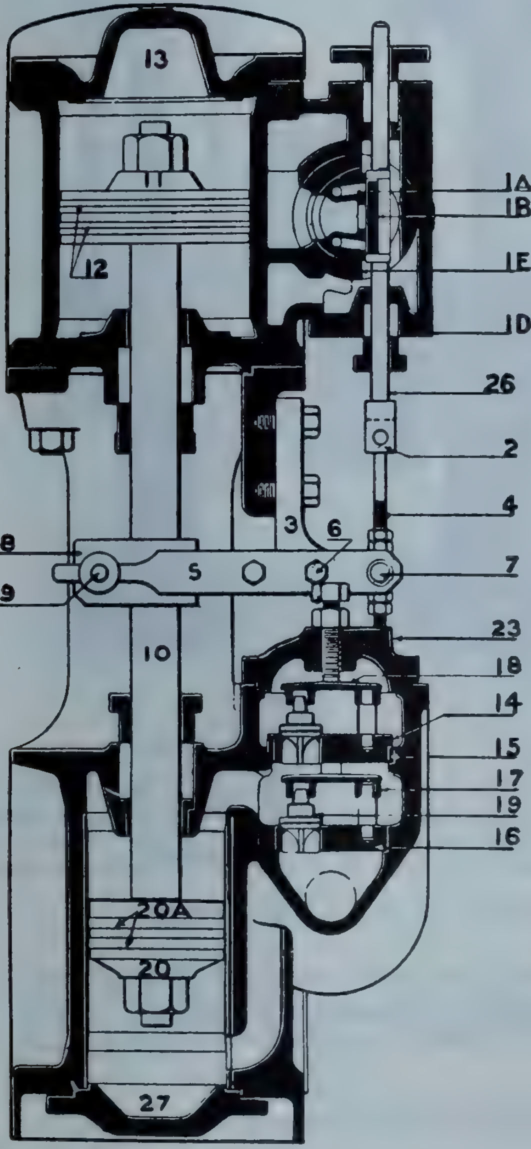
Huessener also states that there is no doubt but that the efficiency of gas-fired boilers can be increased to 90 per cent. by employing mechanical pressure regulators for the purpose of producing uniform conditions; by providing air heaters; by giving the brickwork a thick coating of tar to keep out undesired air; and finally, by employing water-tube boilers with low radiation losses.

Service Applications of "Weir" Steam Driven Pumps

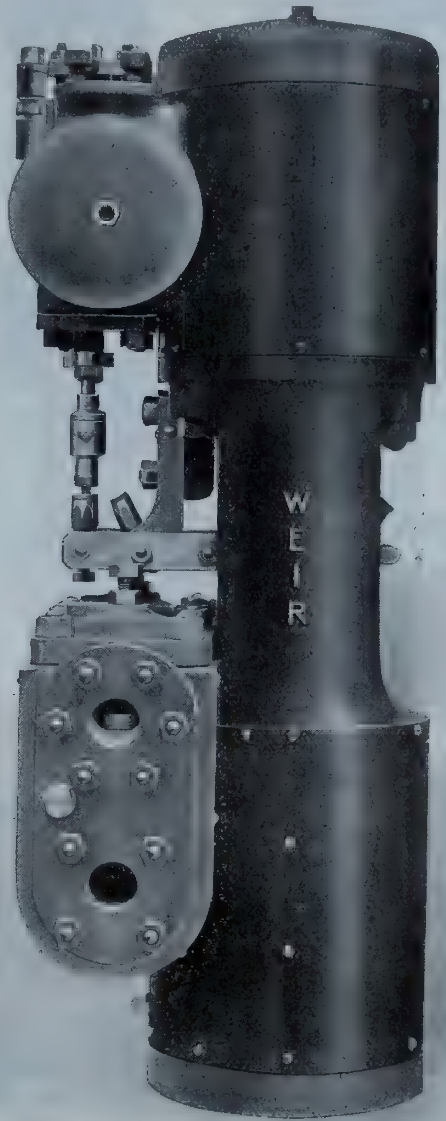
Staff Article

In our November issue, the design, construction and operative features of the valve mechanism with which the various Weir pump products are equipped, was dealt with at considerable length. The reliability of service rendered is indicated by their adaptation to every sphere of steam engineering practice—stationary, marine and locomotive.

AMONG the standard types of marine equipment manufactured by the Weir Co. there may first be noted the arrangement of a Pair of Pumps and Direct Contact Feed Water Heater. In this layout, the main engine feed pumps are fitted in the usual manner, but have a change valve fitted on the main feed pipe with a branch leading to the heater. Drawing from the hot well they discharge direct to the heater, which is always placed as high in the ship as possible. These pumps draw from the heater and discharge to the boilers. They are usually fitted with suction connections from the hot well, condenser and sea, and two discharges, one to the main feed check valves and the other to the auxiliary feed check valves. The pumps are independent of each other and duplicate in every part, with the exception that one pump is generally fitted with a cast iron liner and steel piston rod, the other having a sea suction being fitted with a gun metal liner, bucket, and cold-rolled manganese bronze rod. The iron-lined pump is used chiefly for feeding the boilers when the heater is in operation, but the brass-lined pump should always be used when drawing water from the sea.



SECTION THROUGH "WEIR" LOCOMOTIVE BOILER FEED PUMP.



"WEIR" VERTICAL TYPE LOCOMOTIVE FEED PUMP.

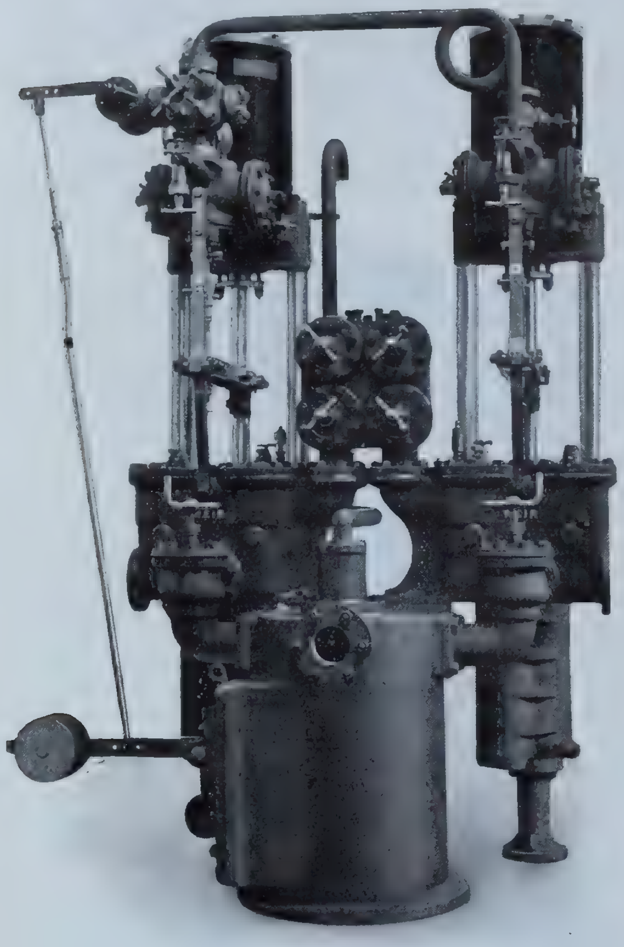
One pump is usually sufficient to deal with the entire feed water and the other can be kept as a stand-by in case of emergencies. The action of the pump is automatic, as a float in the heater controls it, and the exhaust is usually connected to the low pressure casing or condenser. The pumps can be arranged to circulate through the boiler when raising steam, and where this is done it is usual to fit the pump bucket with gun metal packing rings instead of ebonite rings, the latter not being suitable for dealing with water over 190 and 200 degrees F. At higher temperatures the ebonite is likely to soften and seize on the pump cylinder walls.

Single Pump and Direct Contact Heater.

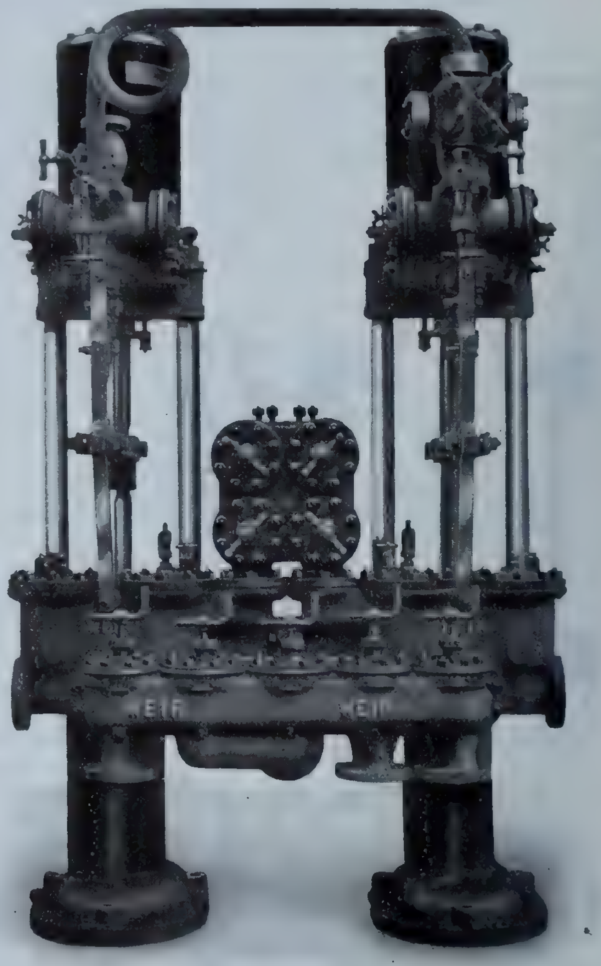
This arrangement is similar to the above except that only one pump is fitted instead of two and this draws from the heater and discharges to the boilers. It is usually made to draw also from the condenser, and is generally fitted with cast iron liner, steel piston rod, etc. It may also have hot well and sea connections. When the latter is required, the pump is provided with gun metal liner, bucket and cold rolled manganese bronze rod.

Pair of Pumps, Float Tank and Direct Contact Heater.

When this arrangement is installed, feed pumps are not required on the main engine. A float tank with automatic float gear similar in principle to that in the feed heater is placed under the feed pumps and into this the air pump discharges the feed water. One of the pumps draws from this tank and discharges to the feed heater, this pump being regulated by the float in the tank. The other draws from the feed heater and discharges direct to the boilers, and is regulated by the float in the heater. The pumps are in duplicate, one being fitted with gun metal liners, etc., and they are arranged so that either can discharge to the heater or the boilers. In case of an accident happening to one of the pumps,



PAIR OF MARINE FEED PUMPS WITH FLOAT TANK AND CONTROL GEAR.



PAIR OF "WEIR" MARINE BOILER FEED PUMPS.

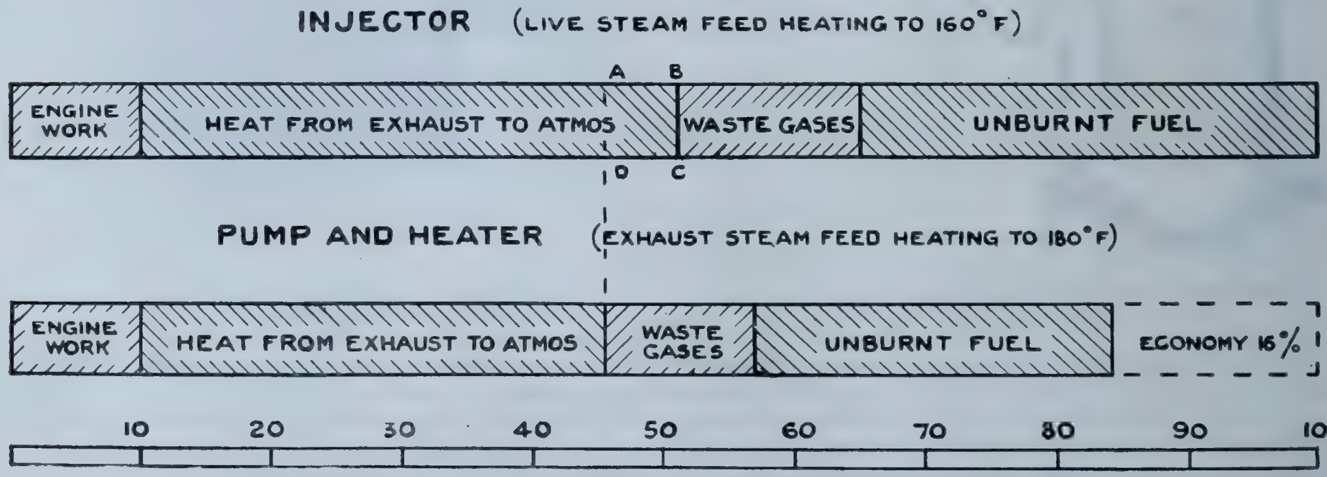
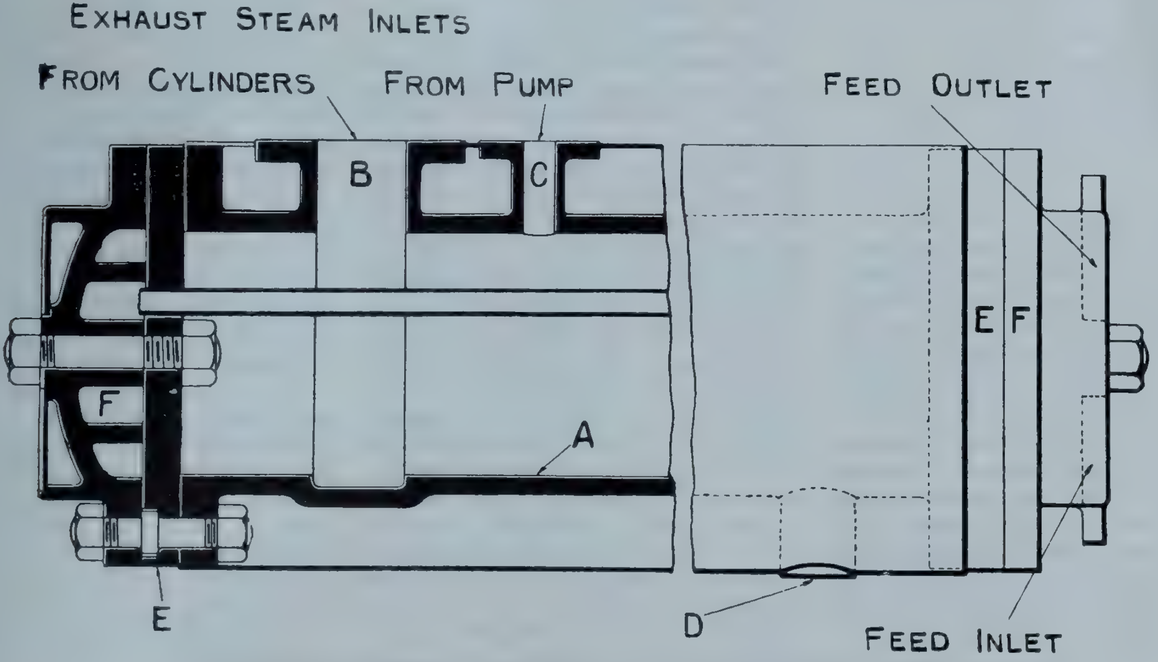


DIAGRAM OF SAVING IN FUEL EFFECTED BY USING "WEIR" FEED HEATER AND BOILER FEED PUMP AS COMPARED WITH INJECTOR.

the other can feed direct to the boilers from the float tank without using the feed heater, but a third pump is sometimes supplied to act as a stand-by.

Pair of Pumps and Float Tank.

In this arrangement, feed pumps are unnecessary on the main engines, a pair of pumps and float tank being used to deal with the feed water heater. This arrangement is fitted in a great many vessels where the engines run at a high speed, and it is accordingly inadvisable to use pumps on the main engines. With these independent pumps, the water is returned to the boiler independent of the main engines, and the engineer has two pumps automatically controlled by the quantity of feed water; each pump being capable of doing all the work when the engines are running at full power. The water is discharged by the air pump to the float tank placed under one of these pumps in any suitable position, and as this is placed lower than the float well there is no extra strain on the air pump. In this tank the usual float arrangement is placed which regulates the speed of the pumps. The pump draws from the float tank and discharges direct to the boilers, the second pump acting as a stand-by, or both can be used together. Both pumps have gun-metal liners and buckets, and cold-rolled manganese bronze rods. They have usually separate discharges to main and auxiliary feed checks.



PART SECTION, "WEIR" LOCOMOTIVE BOILER FEED WATER HEATER.

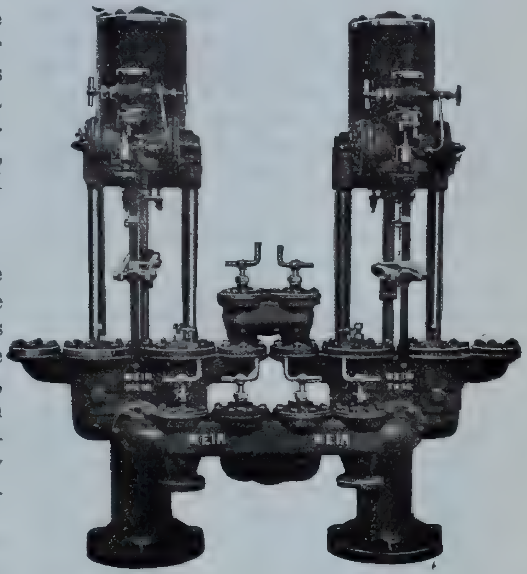
The direct contact feed heater is not used with this arrangement, but the feed may be heated in two ways—first, by leading steam from the L.P. receiver and the exhaust of the pumps and other auxiliaries to the float tank through a non-return check valve. This valve should be fitted immediately under the diaphragm in the upper part of the tank, so that the steam may not impinge upon or damage the float. It is not advisable to raise the temperature above 180 degrees F., as the pump has to lift the water two or three feet, and a higher temperature would interfere with its working. The other method is to use a surface feed heater which is placed between the pumps and boilers, forming, in fact, a portion of the main feed pipe.

Single Pump and Float Tank.

This arrangement is similar to the previous arrangement but without the second pump as a stand-by; and in this case the surface feed heater can also be used as above. In all of the foregoing, arrangements, the pumps are fitted with a steam connection direct from the boilers to enable them to draw from any source independent of any float regulating gear which may be fitted.

Units as Applied to Locomotives.

The boiler feed of locomotives has been chiefly by means of injectors. There have, however, been many experiments made with locomotive feed pumps in Europe. In fact, for over thirty years, these tests and experiments have been going on, and the savings in many cases over the existing forms of feeding have been rather a surprise, there being to-day many European roads using a pump to feed their locomotive boilers to the exclusion of all other methods. In all cases, feed water heaters are also installed. The Weir pump has been applied to this use with very satisfactory results.



PAIR OF "WEIR" PUMPS FOR LAND INSTALLATION.

Our Canadian railroad companies have stuck very closely to the injector and inspirator, but they have about reached the limit of locomotive capacity in so far as size and weight is concerned, and any further increase will have to come through the channels of increased efficiency. When this fact became evident then the merits of the feed water heater and the boiler feed pump were investigated. The result is that we now find our great railways using Weir pumps in conjunction with a feed-water heater to great advantage. The heater utilizes some of the exhaust steam to heat the water, and is arranged in such a way as not to interfere with the draught, which this exhaust passing through the chimney is depended upon to give the fires.

The locomotive feed pumps are built in both vertical and horizontal units, and the results in some comparative tests made in Europe have shown a saving in fuel of about 16 per cent. The reliability of the system has been, we understand, fully proved. It has also been shown that its adoption is economical on the small yard shunting locomotives as well as on the large main line types. The additional weight is largely unimportant.

Key to Loco. F. P. Sectional View.

1A.—Main slide valve.
1B.—Auxiliary slide valve.
1C.—Main slide valve bells.
1D.—Bottom cover of piston valve chest.
1E.—Liner for piston valve chest.
2.—Double joint.
3.—Front stay.
4.—Bottom spindle.
5.—Valve gear levers.
6.—Front stay bush.
7.—Ball crosshead.
9.—Crosshead pin.
10.—Piston rod.
11.—Piston body.
12.—Piston rings.
13.—Cylinder cover.
14.—Discharge valve seat.
15.—Discharge valve seat ring.
16.—Suction valve seat.
17.—Suction valve guard.
18.—Discharge valve guard.
19.—Water valves.
20.—Bucket.
20A.—Bucket rings.
23.—Valve chest cover.
26.—Auxiliary valve spindle.
27.—Pump bottom cover.

* * *

Grease Lubricants.—Solid fats and greases are useful for lubricating machinery, etc., in places where fluid lubricants will not hold, or where the loss of these would be too great. The most of these solid fats and greases are prepared by treating mineral, vegetable or animal oils and fats with a lime soap. Analyses of the products give no indication of their lubricating value and this can be ascertained only by actual trials in oil testing machines. It is necessary in the use of these solid fats and greases that the surfaces or parts requiring lubrication should be brought by friction to the temperature at which the grease or fat melts. This temperature must not be too high, otherwise considerable loss of power will be entailed. On the other hand, the melting point of the grease must not be too low, otherwise loss will result in summer weather and in hot workshops.

The Method and Manner of Laying-Out Plates

By Joseph W. Ross

The laying-out of plates to form the various shapes for which sheet metal parts are used involves difficulties that are only discovered when such a job is undertaken. System and intelligent application are therefore of the greatest importance in procuring successful results.

PARALLEL DEVELOPMENT OF CLYINDERS.

WHERE cylindrical work is to be fitted to an angular or irregular surface, the shaping of the sheet so as to roll up to the required angle demands that a development of the angular edge be made. This development is simply the stretch-out of the angular surface. The development of a plain cylinder would be a rectangle and that of a beveled cylinder would be a rectangle with one curved edge, as will be seen.

In Fig. 8 is seen the plan and elevation of a cylinder cut at an angle of about 30°. In developing this, it is necessary to draw it out full size on a spare piece of plate, but for home study it may be reduced to a smaller scale, according to the wishes of the student. The figure A C D E B represents the elevation view. Above this, describe a circle to represent the plan, and divide the circle into a number of equal parts as deemed necessary. In this case, 16 parts have been chosen. Number each part from 1 to 16 in their consecutive order. Greater accuracy can be obtained in the development by the use of a larger number of divisions.

From each divisional point in the plan Fig. 8, draw to A C and B E D, lines parallel to the intersection of the inclined line C D as shown in the elevation, Fig. 8. It will be observed that if the line circle of the plan be straightened out, the divisional points maintaining their equally spaced positions, that the straightened line or the stretch-out of the circle will be equal to the circumference of the circle divided into 16 equal parts. Each division will represent the starting point of one of the parallel lines, which cut the angular part of the elevation. The diameter of the circle is 14 in. Its circumference or stretch-out is, therefore, by the decimal formula, 3.1416×14 equal to 43.98 in. By the fractional formula, $14 \times 3\ 1\text{-}7$ equals 44 in., which is quite near enough for practical purposes.

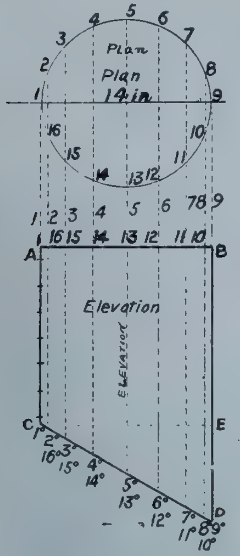
Measure off on the required plate, a stretch-out of 44 inches. As the part A B C E, Fig. 8, constitutes a right cylinder (one that is square at both ends), it will require a rectangular section of plate; therefore, bisect the line A B A on the development, Fig. 9, and square up the plate, using the height A C or B E. It will now appear, after squaring up, as the rectangle A B A and C.E.C. Divide the lines A B A into 16 equal parts and with the dividers in conjunction with the lath, transfer all these points to the line C E C. Connect these points by lines parallel to lines A C and B D. Number all lines as shown in Fig. 9, obtaining the numbers from the plan view in Fig. 8, and allow all the parallel lines to project below the line C E C.

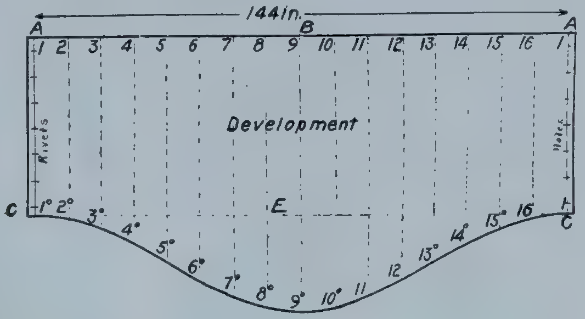
From line A B, Fig. 8, measure with the trams, the length of line 1.1° and transfer this length to 1.1° on the development Fig. 9. Measuring from line A B again, reset the trams to distance, 2.2°, Fig. 8. Mark this off on corresponding number in the Fig. 9, and reset the trams to distances 3.3°, Fig. 8, and so on until all the lengths of parallel lines in the elevation view, Fig. 8, are transferred to corresponding numbers on the development Fig. 9. Measure in each case from A B, Fig. 8, and transfer the measurement to the plate, working every time from the line A B A. Connect all the points thus located with an even curve, as shown by the curved line C C. Mark off the rivet holes and add the required laps.

In Fig. 10 is shown a cylindrical chute of ⅜-in. plate fitted to the bottom of an angular bin. Divide the neutral circumference view into 12 equal parts, and from these points of division extend parallel lines to the angle of the bin M R N. Number each line as shown in Fig. 10. Now calculate the stretch-out of the plate. The neutral diameter is, therefore, $16 + \frac{3}{8} = 16\frac{3}{8}$ ins. The neutral circumference or stretchout equals $16\frac{3}{8} \times 3.1416$, which is 51.4, or 51 13-32 ins.

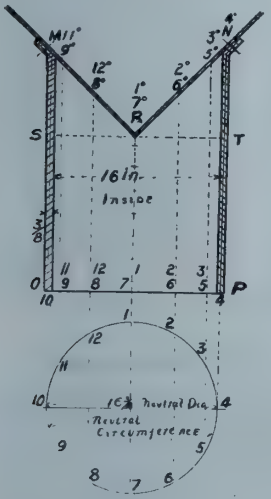
Measure off a distance equal to 51.4 inches; bisect the line and square up with a height equal to S O or T P. This gives the development of the right cylinder S O P T. To this must be added the sections M S R and R N T, the development of which will now be explained. Divide the line XX into 12 equal parts in accordance with the divisions in Fig. 10. Transfer these points from XX to YY and connect by lines parallel to XY, XY, prolonging these lines some distance past the line YY. Number each line in manner similar to Fig. 10.

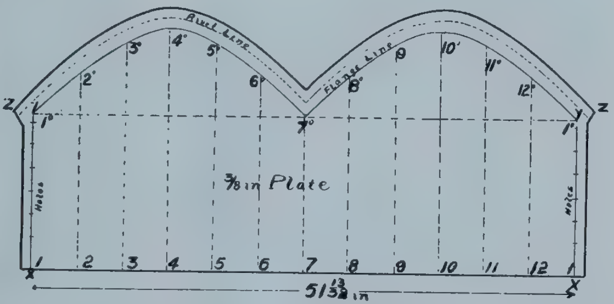
Set the trams to distance 1.1° of Fig. 10, and transfer this length to line 1.1° in Fig. 11. Reset the trams to distance 2.2° and transfer this distance to 2.2° in Fig. 11. Continue this process with each point of identification until all have been transferred to Fig. 11. Connect all the located points with an evenly drawn curve. Mark off from lines XY, XY, 1½ inches for laps, and divide the rivet line into the desired equal number of rivet spaces.





FIGS. 8 AND 9. ELEVATION AND DEVELOPMENT OF CYLINDER WITH ONE BEVELED END.

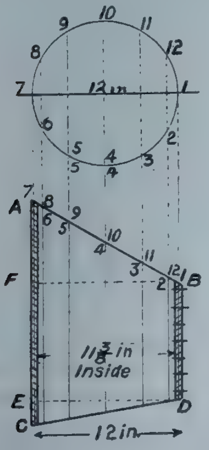


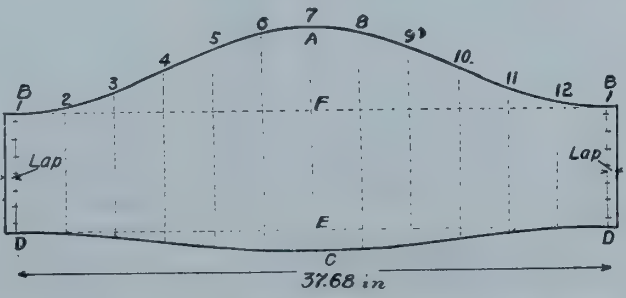


FIGS. 10 AND 11. V-SCHUTE CONNECTION FOR BIN AND ITS DEVELOPMENT.

Measure from the developed curved line a distance of 3 inches for the flange allowance and also space off the requisite number of rivet holes on the rivet line of the flange. These holes may be punched in the templet, and after rolling fitted into place so that the holes may be marked off on the angular bin which is afterwards drilled. If the holes are already in place in the plates of the bin, they may be omitted in the templet until after being rolled and fitted into position, being then marked off on the templet and drilled or punched, according to conditions and facilities. An addition is required at the points ZZ to counteract the drawing in of the metal during the operation of flanging. In general practice it is advisable to allow plenty of metal. If too much is allowed, it is easily removed after flanging and good work is assured.

The completed templet is shown in Fig. 11. It is also necessary to note that one of the points, Z (the one on the inner lap), is thinned out or scarfed to permit the plates to be closed up at the point of contact with the side of the angular bin. In Fig. 12 is shown a cylinder bevelled at each end. The pattern is seen in Fig. 13, which will readily be understood after following closely the foregoing examples.





FIGS. 12 AND 13. ELEVATION AND DEVELOPMENT OF CYLINDER WITH TWO BEVELED ENDS.

The next article of this series will illustrate the principle of obtaining the developments of conical forms by radial lines. The method of obtaining the camber as in the telescopic system of plating used in smokestacks, blast pipes, water pipes, lines, etc., will be explained and illustrated.

* * *

CORLISS ENGINE DASHPOTS.

DASHPOTS on a Corliss engine, says a U.S. contemporary, should receive as much attention as the governing mechanism, for the latter will have little or no effect on the speed, and the steam economy will be low if the dashpot pistons do not close quickly. If the dashpots are sluggish in action, the engine may even run away. A little oil dropped in the dashpots now and then will prevent leakage between the piston and cylinder and will also prevent scoring which may give rise to trouble later. Indicator cards will show whether the governing mechanism or dashpots are the cause of poor speed regulation or high steam consumption.

If the admission curve drops off gradually before the expansion curve starts in, it shows that the admission valve is not closed quickly enough and that the steam is being "wire-drawn." If this be the case, the dashpot pistons may be too snug or they may be worn and leak air. In either event, the trouble should be remedied to get the full advantage of automatic cut-off.

* * *

Crane Operation.—The careless craneman, although provided with the best facilities for safe handling of materials, may by his carelessness thwart the most careful plans of a management for the safety of its employees. Similarly, the craneman who is well meaning but not thoroughly familiar with the cause and effect of right and wrong applications of the crane mechanism, may blunder into a most disastrous accident. It is therefore imperative that cranemen should be thoroughly impressed with safe ways of handling the cranes under their charge.

* * *

The Canadian Fairbanks-Morse Co., Toronto, have secured an order for fitting up the A. Muirhead & Co. new plant at Toronto with "Skefko" ball bearings.

The Importance of Steam Boiler Inspection and Insurance*

By S. F. Jeter **

The chief function of boiler insurance is the prevention of rather than the indemnification for loss, and it is worthy of note that the life extension feature of steam boiler service has been a fundamental principle of boiler insurance since the inception of the latter, through the medium of periodic examinations of the risk.

THE value of boiler inspections both to the assured and the insuring company can never be fully measured. The mistakes of the inspector always stand out in bold relief after an accident as also the soundness of his advice when compliance with his recommendations and demands could be assumed to have prevented the accident, but how many explosions are prevented by timely warning and advice that is heeded can never be known. All comparisons regarding the relative number of accidents between boilers that are insured and those not insured seem to indicate that the uninsured boilers, which in nearly all cases mean the uninspected boilers, are very much more liable to explode than the insured boilers. The present day "safety first" movement has apparently taken all by storm, but if full credit is to be given where credit is due, it must be remembered that boiler inspection was the first "safety first" movement placed on a business basis. Before telling you how inspections are made, it will be in order to briefly describe the qualifications required of boiler inspectors.

Boiler Inspector's Qualifications.

It is the first duty of the boiler inspector to prevent accidents to the boilers under his care, and after that to give such advice as will prolong their life, reduce the operating costs to the owner. He is then liable to become a general instructor and walking encyclopedia for the plant operatives, particularly in mechanical matters, but often is required to give advice in connection with family troubles. A good boiler inspector, to a casual observer, is an ordinary mortal, but in realty he is a wonderfully constructed being. He must possess a large assortment of apparently contradictory virtues. The layman naturally assumes that if a man knows boilers and can tell when repairs should be made and how to determine safe pressure, he is fully equipped as an inspector. If this were true, the insurance companies would have to hire a corps of bouncers to get rid of the applicants for inspectorship.

An inspector must of course know boilers thoroughly; in fact, he must know them so well that he feels confident that his recommendations or demands are absolutely right. On the other hand, he must be anything but bullheaded, and always open to argument, and be broad-minded enough to at once admit error if he finds he has taken an incorrect view owing to a lack of knowledge of all the facts or from any other cause. He must be a close student of human nature, and know just how to approach an assured in order to get desired repairs made. Some people can be handed on idea, metaphorically speaking, on a silver waiter and assimilate it at once, while others require the use of an axe in order to make an impression. The inspector must be fully capable of deciding at once whether the silver waiter or axe is to be used, and if the wrong vehicle is employed, no end of trouble results, and often a good risk is lost for the want of a little tact.

Moral and Physical Backbone Necessary.

The inspector must have a backbone without joints when it comes to arguing a case with an assured who demurs regarding changes that are necessary for safety. He is often given honeyed words and false praise in an endeavor to cause him to recede from demands for changes or recommended condemnation of unsafe apparatus, but if he knows he is right he must turn a deaf ear to all such blandishments.

The inspector must be physically robust, for boiler inspecting is no child's play, being one of the most fatiguing of occupations. He is often required to undergo severe temperature changes; notwithstanding, the inspection of boilers is a very healthful occupation owing to the exercise and outdoor nature of the work. He should be gastronomically built like a camel and learn to eat and drink when he reaches a point where food may be obtained. He must be capable of expressing himself well, both orally and in writing, for it is only by properly presenting his findings that he can hope to impress the assured with the value of his work. He must be cosmopolitan in every sense of the word, for while he necessarily comes in contact and must treat in a manner to retain the friendship of the lower grade employees in a plant, he must also be capable of meeting the higher officials on an equal footing.

Two Classes of Inspection.

Boiler inspections are divided into two general classes, usually termed external and internal, but the names would better designate their nature if they were called operating and general. The external inspection is usually made without any previous notice to the assured and the inspector's duties are such that the operation of the plant is in no way interfered with, providing, of course, everything is found in order. To make an internal inspection of a boiler, it is necessary that it be idle and empty and the manhole and handhole plates removed, as well as being otherwise prepared for examination. I will first describe the internal or general inspection because the first of such inspections is the one required for the approval of the risk for insurance.

It will be assumed that an application for insurance on a plant consisting of three boilers of the horizontal return tubular type has been secured and the inspector is assigned to make the inspection and report fully, giving the highest pressure for which these boilers are insurable. We will leave out the details of how he reaches the plant, assuming that he has been given definite directions in regard to its location, although I can assure you that finding the boilers is sometimes no mean part of his task.

The General Inspection.

On arriving at the plant, the inspector should endeavor to see the owner or the one highest in authority. It is best to do this even if nothing more is done than to shake hands and let the owner know that you are on the ground. First impressions are the most lasting, and it is very essential that the boiler inspector make a good first impression on the management of a plant before offering criticisms which the inspection may disclose as necessary. The next step is usually that of being directed to the boiler room where are usually to be met the chief engineer and other plant attendants. At this meeting, the inspector's ability to size up his man is most required because the plant employee can make his task difficult or otherwise as he may see fit, and he also can be of inestimable value in imparting information regarding operating conditions which the inspector could not hope to obtain in any other way.

In making the inspection it is important that a fixed scheme be followed, that is, each inspection of a return tubular boiler should be made in the same way. The particular routine observed is not of great importance, but sticking to the same routine for each inspection is very necessary; otherwise some points are very liable to be overlooked. On reaching the boiler room containing the three boilers to be inspected, the logical procedure is to first make a general survey of the surroundings to ascertain how they affect the risk. Often an accident of a minor nature has resulted in the injury or death of an employee, causing mental anguish as well as physical pain, and besides an expense to the assured or insuring company which could have been prevented by providing reasonable means of exit. The blow-off connection is a fruitful source of such accidents. The blow-off valve is often located so that the man operating it is in a closely confined space with the piping so arranged that a break at any point during the act of blowing off is likely to cut off all means of escape. It is the inspector's duty to recommend the necessary changes required to prevent such an occurrence. He should examine the location of the boilers with a view of determining the probable damage to surroundings should an explosion occur. This is particularly important in case of very large coverage or use and occupancy insurance. While the foretelling of the damage likely to result from an explosion is practically impossible, the general exposure of machinery and employees can be more or less well determined.

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*From a paper read recently before the Insurance Institute, Hartford, Conn.

**Supervising Inspector, the Hartford Steam Boiler Inspection & Insurance Co.

Inspection Details.

The steam and water piping as a whole has to be carefully considered to see that there are no connections that may lead to accidents or dangerous conditions of operation. The feed appliances such as pumps, injectors, etc., and the piping between them and the boilers must be inspected for safety as well as general plan and capacity, so that the boilers may at all times be supplied with an abundance of water to meet the maximum capacity they are capable of delivering.

The blow-off piping outside of the boiler setting must be thoroughly inspected for, notwithstanding the fact that the coverage of a boiler insurance policy usually ceases at the blow-off valve, the arrangement of piping beyond this point is often such as to produce conditions which may react on the parts included within the coverage. With separately set boilers, the connecting pipes to the water space of the boilers must be examined to see that it is separate and distinct, with check valves properly arranged to prevent the transfer of water from one boiler to another. In some cases with heating plants working on very low pressures and gravity returns, it is found best to do away with check valves between the boilers. The steam pipes must be so arranged that no pockets will be formed to trap condensation and must also be connected so that the movement due to expansion and contraction can take place without undue strain on any of the parts. Many lives have been sacrificed owing to a lack of precaution and forethought in suitably arranging steam piping.

The Water Column.

An examination of the connections and attachments for determining the water level must be made for no matter how strongly a boiler be built, if the water line be continually carried below the fire line, even a small amount, disaster is almost certain to follow sooner or later. Water columns are frequently found set so low that the safety of the boiler is endangered. The blow-off or drain connection from the water column is examined to see that its size is ample. The connection from the steam space of the boiler to the top of the water column must be inspected to see that there are no connections on this pipe that are required to furnish a supply of steam for other apparatus, or that water can be trapped in the pipe. Either of these conditions will render the indications of the water level inaccurate.

Whether the location of the steam gauge is correct or not must be determined; frequently a gauge is so connected to a boiler that the steam comes in direct contact with the spring or the gauge is fastened so that it is exposed to heat from some part of the boiler or smoke flue. either of which conditions render its indications inaccurate. The safety valve is a very important attachment and deserves the closest scrutiny to determine its condition. The escape pipe from a safety valve is often a source of danger and the inspector must see that it is properly drained and well supported to prevent undue strain on the valve.

If the boilers be of the suspended type, the ability of the supports to safely carry the load must be determined. This usually requires complete data of columns and supporting members as well as sizes of hangers, etc. The determination as to whether each support is carrying its proper proportion of the load is just as important as regards the boiler safety in any other respect.

Inside the boiler.

The inspector, after writing the answers asked on his data slip regarding the various parts examined so far, enters the top manhole of the boiler, with light, rule, calipers, hammer and usually a depth gauge. He first carefully examines the condition of the parts. The shell may show evidences of pitting, especially along and just below the water line. The tubes may be pitted, or thin from general corrosion. The braces may be weakened by corrosion or they may be loose, due to strain or improper fitting. The soundness of the braces is usually determined by striking them with the hammer as well as by visual inspection. The shell is carefully sounded to determine if there are indications of cracks or laminations in the material. Many of the rivets are sounded for tightness. The condition of the upper portion of the boiler as regards scale or oil deposits is ascertained and it is not uncommon to find the spaces between the tubes against the rear heads completely stopped with scale for a distance of a foot or more. Such conditions are very likely to lead to serious trouble, if not explosion. Any indication of oil in a boiler is a serious matter, for there is no substance likely to reach the interior of such a vessel that can produce an effect at such wide variance with the apparently harmles nature of the cause. All openings to outside attachments or connections are examined to see if they are free; many boiler explosions having been caused by a stoppage of the water column connection. Where connections are supplied with a pipe screwed into a part of the boiler or into a flange riveted to the shell, the inspector must note whether the screwed joint has been fully made up.

Strength Calculations.

Since this inspection is assumed to be the first one made of the boilers under question, the inspector must obtain the necessary data for calculating the strength. He must know the distance between the shell and tops of tubes to correctly estimate the amount of bracing required. He must know the number and size of braces at their least section on each head. The number and size of rivets attaching the braces to both the head and shell must be known so that the weakest element in the construction can be taken into account in calculating the strength. The thickness of the heads must be ascertained in order to estimate the strength of any unstayed surfaces and to judge whether a suitable bearing surface has been supplied against which the tubes were expanded. The pitch and size of the rivets must be obtained as well as the design of the joint, so that its strength relative to that of the solid plate can be determined. The size of the rivets is usually judged from the dimensions of their heads. The thickness of the shell can usually be measured by means of a depth gauge applied along the edges of the plate at the girth seams, while it can often be calipered at an opening in the shell. If there be a dome on the boiler, the details regarding the bracing of the head as well as those of the connection to the shell must be secured, also the dimensions of the reinforcement around the opening from the boiler to the dome, should this opening be of large size.

The next part to be examined is the interior below the tubes if the boiler be supplied with a manhole communicating with this part of the structure. The usual points to be given attention here are the soundness of the bracing, condition of the shell as regards corrosion or other defects; also heads and tubes, and to note the quality and quantity of the scale attached to the surfaces. Quality of scale is just as important as quantity in regard to its ability to injure a boiler or detract from its economical operation. The tube cleaner salesman and the boiler compound man frequently quote tables giving the different efficiencies of operation due to fixed thicknesses of scale in boilers. While there is more or less regular change in the efficiency of a boiler with varying thicknesses of scale of the same quality, **it is pure buncombe to state that a given thickness of any kind of scale will reduce the efficiency a fixed amount.** Proper make-up of the blow-off pipe is determined while the inspector is in the lower part of the boiler. If there be no manhole below the tubes, the information specified above is determined as well as possible while in the upper part of the boiler and also through the handholes which are usually supplied in the front and rear heads of such boilers.

Heads and Furnace.

After completing the internal examination, the inspector should examine the front heads externally. Here corrosion of the head and tube ends is very likely to occur, especially if the boiler be fitted with a stack connected directly to the extension sheet, for under these conditions rain may come down the stack during idle periods, and the sulphur deposit in the stack and on the head from the furnace gases combined with the moisture cause extremely rapid corrosion. The front must be next examined to determine that no weight of the boiler is carried on it.

The inspector on entering the furnace should note the condition of the fire sheets and seams, and should make a careful examination of the surfaces to locate any brands or stamps which are placed on the sheets by the manufacturers of the material, and from which the tensile strength of the plate can usually be obtained. If rivets leak, it is the outside of the boiler that usually reveals this fact and when leakage is discovered its cause has to be ascertained, so that necessary recommendations can be made. Leakage of the girth seams may be caused in many ways; if from scale or oil deposit, the inspection of the interior already made will generally reveal the cause. Poor workmanship in making the boiler will usually be evident to the experienced inspector.

Shell Leakage and Corrosion.

The location, shape and size of the bridge wall which forms the rear limit of the grate surface is often the cause of or contributes to leakage at the girth seams. In many types of boilers the improper support is a contributing cause to such trouble. Feeding in the bottom of the boiler through the blow-off connection is a very fruitful source of such trouble. The inspector must examine into all of these phases of the case and recommend the necessary changes to relieve the trouble. He must keep a sharp eye for evidences of leaks coming from the vicinity of longitudinal seams, for any leak from such a location must be regarded with the gravest suspicion, the cause being likely to prove a hidden crack. This defect has brought about some of the worst explosions in the history of steam boiler insurance, and no leak at a longitudinal seam should be considered harmless until it has been proven to be so.

The condition of the setting walls must be noted particularly with respect to their ability to properly support the boiler. The blow-off pipe should be examined to see that it is sound and free at the bottom,—that is, that no weight is resting on it as this is a very common source of accident. The freedom of the blow-off pipe where it passes through the setting wall is also essential to safety as is the proper protection of the pipe from the direct impingement of the flame and highly heated gases of the furnace.

The rear tube ends must be examined for leakage and corrosion, and if such defects are disclosed, the cause must be determined and proper recommendations made. The condition and position of the covering over the rear combustion chamber must be examined, the arches generally used at this point being frequently located so high as to cause overheating of the head above the water line. The fusible plug which is located in the rear head must be inspected to see that the fusible metal is in proper condition to respond to an increase in temperature should low water occur. After examining the blow-off valve and outer portion of the pipe, the steam gauge is tested, and corrected if necessary, the inspection being then completed.

Finishing Touches to Report.

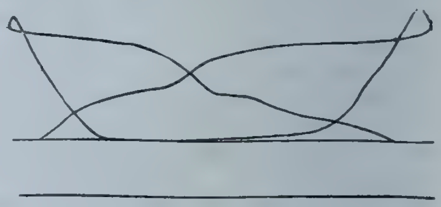
The inspector after completing the examination usually discusses the various points revealed with the chief engineer, and directs him in regard to the making of repairs or the betterment of operating conditions. Inquiry should be made as to the maximum steam pressure required to properly operate the machinery used in connection with the plant as this should be given due consideration in fixing the maximum pressure to be allowed. Before leaving the inspector should endeavor to see the highest in authority at the plant, and discuss with him fully all the facts brought to light. In the average case, the inspector is able to state at once whether or not a suitable pressure can be allowed.

The report of the examination is usually prepared after the inspector returns to his hotel or office, and is reviewed by the chief inspector or someone under direct supervision who edits the report and makes any changes that may seem necessary. If changes to be made are of any importance, the report is held up until the subject can be discussed with the inspector or taken up by letter. The report, after receiving the approval of the chief inspector is typewritten and mailed to the assured.

INDICATOR CARD QUERY.

WOULD you please give me a suggestion as to how to remedy the trouble shown by the accompanying indicator card. It was taken from the high pressure cylinder of a tandem compound high speed McEwen engine, with cylinders 11 and 18 inches diameter by 14 inches stroke, running 250 r.p.m.

In the card in question, all events occur too early in both ends of the cylinder which indicates an excessive angle of advance. This means that the valve is too far ahead of the piston and crank. The greater compression in one end also shows that the valve is not well centralized. This can be corrected by altering the length of the valve connections. The compression loops found are a source of serious loss.



In the case of the McEwen engine, an inertia governor is used in which the eccentric pin is fastened to a swinging arm which operates by changing the travel of the valve and varying the angle of advance slightly. As this mechanism is fastened securely to the governor wheel, we would suggest that this wheel has slipped around the shaft so as to bring it ahead of the crank.—J.P.S.

Electricity and Hydraulics

COMMUTATOR AND OTHER TROUBLES —II.

By H. C. Thomas.

PART I. of this article appeared in our November issue, and discussed the steps to be taken relative to sparking, bedding and spacing of brushes, also the removal of projecting mica. Further common troubles and their remedies are dealt with in the present instance.

When the commutator has become so worn that it is considered advisable to true it up in a lathe, it should preferably be held by two steadies placed at the points where the shaft usually rotates in its bearings. These steadies will help to prevent vibration. The writer has known cases where, in overhauling small motors, the commutator was turned up and the old centres were undamaged, but owing to a slight spring in the shaft, when the armature was replaced in its bearings the commutator was slightly out of truth. This could not have happened if the commutator had been turned up with the shaft running in two steadies at the points where it usually ran in its bearings.

When turning commutators, use a sharp pointed tool, take light cuts, and avoid the use of a file if you can get the desired finish with the tool. Polish afterwards with sandpaper, two or three thicknesses of it in a concave block being best. If any small pieces of copper have dragged over from one segment to the next, remove them carefully.

The commutators of large armatures which can be revolved slowly by an engine or separate motor are best trued up in their bearings, using a turning tool or an emery wheel attached to a portable slide rest. A special commutator grinding machine may be used, rotating the armature by its own engine, and the grinding machine taking its power by belt from the generator shaft. This method is perhaps the most satisfactory, where the expense of purchasing a grinding machine is justified.

Before commencing to true up a large commutator, the bolts of the end plate should be tried to see that they are tight. Care must, however, be exercised in tightening up the bolts under normal working conditions, as the commutator may be thrown out of truth; in fact, the commutator must at all times be treated with care, because owing to the nature of its construction it is easily damaged. It must never be allowed to support the weight of the armature when being removed from the machine, nor must ropes be passed around it when being raised by blocks or crane; the weight should be supported by the shaft.

Commutator Lubrication.

Regarding the use of a lubricant on the surface of a commutator, there is a divergence of opinion, and much depends on the conditions and the amount of attention which the machine usually receives. It will generally be found that the occasional application of fine sandpaper, followed by a clean cloth slightly moistened with good machinery oil, tends to keep the commutator in good order. Excess of oil and lack of cleaning may result in the accumulation of carbon dust and oil on the windings; this mixture being of course a conductor, will tend to cause a breakdown. The use of emery cloth on the commutator or anywhere else on the machine is not advisable.

Air Gap Adjustment.

The correct adjustment of the air gap is a matter which calls for occasional attention, due to wear of the bearings or, what may happen in some bipolar machines, movement of the pole pieces, although this rarely occurs. A hardwood wedge 8 ins. long by ½ ins. wide and tapering from ⅜ in. to a fine edge is a useful little tool for checking this. When inserted between a pole piece and the armature, the amount by which it projects from the former provides ready means of ascertaining whether the shaft has worn down in the bearings and needs re-alignment. This checking should be made at about the middle of the pole-piece. In this connection it should be noted that any downward movement of the armature and consequent lessening of the air gap underneath it tends to throw a considerable extra strain upon the bearings due to the unbalanced magnetic pull, hence the importance of watching for any reduction in the bottom air gap. Some cases of sparking have been cured by increasing the air gap all around, that is, boring out the pole pieces, but it must be remembered that this is done at the expense of efficiency, which falls off rapidly as the air gap is increased.

Hot Bearing Trouble.

A case of persistent hot bearing in a six-pole generator was traced to the fact that the yoke was not in the correct position with reference to the armature, causing considerable end thrust at the enlarged portion of the shaft where it pressed against the bearing. To eliminate the trouble, the yoke was moved in the direction of the axis of the shaft, new bolts being used to keep it in its new position.

Insulation Resistance.

The gradual reduction in the insulation resistance of a machine, which often takes place before an actual breakdown of the insulation occurs, may be detected by the use of an ohmmeter and generator. Where there are a number of motors operating in a plant, particularly where the conditions are severe, the man in charge of them should take periodical readings, say once a month, and each set of results compared with those previously obtained. In this way the condition of the machines may be kept under constant observation, and the chances of a sudden breakdown reduced to a minimum. These readings should be taken as nearly as possible under the same conditions—e.g., after a day's run, because the readings will not be the same when the machine is hot as when it is cold.

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Factory Lighting.—In a paper before the Illuminating Engineering Society, New York, M. H. Flexner and A. O. Dicker discussed the general principles of adequate factory lighting, and showed that the cost of such lighting is under 1 per cent. of the wages of the workmen, whereas, by its means, the increase in output is at least 5 per cent. It is stated that for very good lighting a 100-watt lamp is required for each 100 square feet of working area, which is the average space required by a workman.

Internal Combustion Engines

STARTING INTERNAL-COMBUSTION ENGINES.

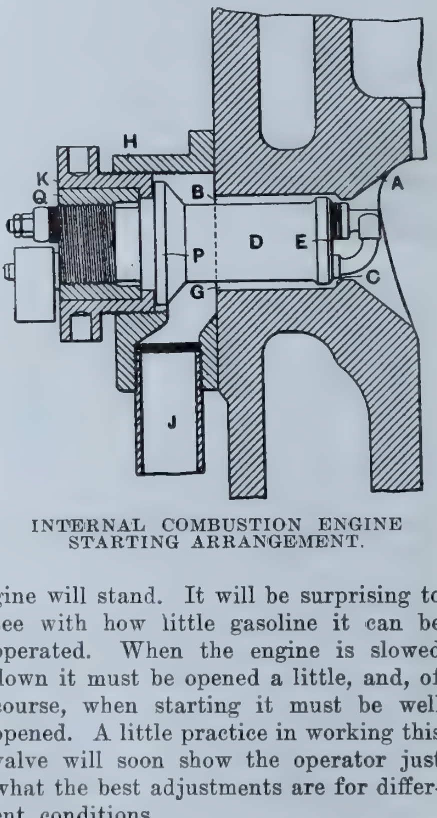
A METHOD of starting internal-combustion engines has recently been patented by A. R. Bellamy, Spittlegate Ironworks, Grantham, England, in which the compressed air or gas for starting purposes is introduced around the ignition plug, which normally closes the inlet passage for the air or gas to the cylinder, but which can be adjusted to open the passage when the engine is to be started. The accompanying sectional elevation illustrates the arrangement, and shows the ignition plug raised from its seat in order to allow the compressed air to enter the cylinder. A is the cylinder end and B the inlet for the passage of compressed air or gas to the cylinder for starting purposes. C is a mitre seat formed at the inner end of the inlet passage B, and D is the ignition plug which is provided with the usual contacts for making and breaking the electric ignition current and with a mitre seat E adapted to fit the mitre seat C. This plug D is of less diameter than the inlet B in the cylinder end, so that an annular space G is provided around it. H is the air-box or chamber which is arranged on the cylinder end, and the interior of which is in communication with the inlet passage B. J is the branch which is laterally provided upon the air-box for the admission of the compressed air or gas for starting the engine.

An internal screw-thread is formed in the air-box or cylinder H, and K is a lifting nut in the form of a hollow cylinder having an external screw-thread which engages with the internal screw-thread of the air-box H. An internally-screwed sleeve fits into the hollow nut K, by means of which this nut is loosely attached to the ignition plug by the engagement of its screw-thread with an external screw-thread upon the outer end of the plug. The plug D is normally—that is to say when the engine is running—screwed down on to the seat C by the operating nut K. When, however, the engine has to be started, the nut K is turned so as to move the plug D from its seat, thus opening up communication between the air-box H and the cylinder.

DEVELOPMENT OF THE MODERN GAS ENGINE—II*

By J. E. Palmer.**

THE majority of gas engines are operated with the mixture too rich. One reason for this is that the mixture must be rich in order to start the engine, and then it is not changed after the engine is started. With a carburetor fitted with a gasoline-controlling needle valve, as before explained, the mixture can be adjusted at will while the engine is running. The mixture at all times should be kept just as lean as possible. This will economize fuel and prevent spark plugs and cylinders becoming foul. After the engine is running and has become well heated up, close off the needle valve gradually, just as much as the engine will stand. It will be surprising to see with how little gasoline it can be operated. When the engine is slowed down it must be opened a little, and, of course, when starting it must be well opened. A little practice in working this valve will soon show the operator just what the best adjustments are for different conditions.



INTERNAL COMBUSTION ENGINE STARTING ARRANGEMENT.

Graphite as Lubricant.

Graphite judiciously used in small quantities is an excellent lubricant when mixed with oil or grease. It is particularly good for the walls of the cylinders of gas engines, as it is not affected by the high temperature produced by the combustion of the explosive mixtures. The oil burns up while the graphite remains. Graphite, however, has got into bad repute in many instances by too much of it being used, and the greatest of care should be taken to use it only in small quantities, as any considerable accumulation is liable to stop up oil holes and pipes and clog up exhaust passages.

Powdered flake graphite may be efficiently mixed with the grease and oil. About a quarter of a teaspoonful should be put into an oil-squirt can containing oil, and well shaken up before using, as the graphite is heavier than oil and settles to the bottom if not well mixed. In engines where the splash system only is used, about an eighth of a teaspoonful of graphite may be put into the oil pocket under each cylinder once each month. When the crank case is cleaned out and new oil substituted, twice this amount of graphite may be used in each pocket. Where there is a forced-feed return-oil system, the use of graphite is not recommended, as it is liable to collect in the oil pipes and clog them up. A small quantity blown into the cylinders, mixed with the oil, or applied to the walls of the cylinders occasionally, will be found very beneficial.

Acetone for Carbon Removal.

Despite the most intelligent care that may be exercised in regulating the consumption of gasoline and oil, carbon will form in the combustion chambers, on top of the pistons, and in the exhaust passages of gas engines. One of the best ways of removing this carbon is to use some substance which will loosen it from the containing wall. There are several such substances on the market, some of which are quite good. The main constituent of them all is "acetone" (pyroacetic ether), which is, in itself probably the best carbon remover known. It is absolutely harmless, and, if properly used, will satisfactorily accomplish the purpose intended. Acetone is a commercial product, and can be obtained at most all large or wholesale drug stores. Its use is recommended in preference to all other articles.

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*From a paper before the American Society of Naval Engineers.

**Commander U. S. Navy.

When injected into a warm cylinder, acetone is converted into a gas, and if the cylinder is kept tightly closed for 10 to 12 hours it will separate the carbon from the walls of the cylinder. It does not dissolve the carbon, but simply loosens it so that it falls off from the cylinder walls and may be blown out through the exhaust. About once each month or oftener, the carbon that has accumulated should be removed.

Directions for Using.

Warm the engine by running it about ten minutes or so. The engine must not be too hot, yet it must be warm enough to convert the acetone into a gas. Arrange the valve mechanism so that all the valves are tightly closed and no gas will escape. If this cannot be done, then arrange matters so that half the cylinders will have their valves closed. This is an easy matter, as it is only necessary to crank the engine until one cylinder is on the compression stroke and another one is on the firing stroke; where there is a four-cylinder motor, two cylinders can be treated one day and the other two the next day.

Remove the spark plugs and inject into each cylinder, with an oil gun, from two to four ounces of acetone, being careful to replace the spark plugs ot once before any of the gas escapes. Let the engine stand overnight and start up in regular way next morning, when the carbon can be nearly all blown out through the exhaust.

A little study and practice is required with different types of engines, in order to determine the best temperature, the amount of acetone to use, and how often it must be used to produce the best results. It sometimes happens after using a substance like acetone that a little carbon will lodge on a valve seat and cause a cylinder to lose its compression. In this case, simply grind in the valve with a little kerosene, and this will generally remove the loose carbon off the valve seat. An engine must not be allowed to go too long a time without having the carbon removed, because when the carbon becomes very hard it is difficult to dislodge except by scraping.

While the above directions for taking care of an engine may seem to some, at first sight, to be arduous, in reality they are not. If those who operate gas engines would get themselves into a regular routine of attending to these details they would soon become experts in detecting faults. The work required to be done in properly caring for a gas engine is so moderate and the results obtained so satisfactory that those exercising this care will be amply repaid for their labor.

Design Factor of Safety.

While there may be a sufficient reserve factor of safety established by designers of small gas and gasoline engines, there is no doubt but that the serious impairments which have occurred to both gas and gasoline machinery of extensive if not of moderate horse-power, is due to the inadequate factor of safety that has been employed in designing the various parts of heavy machinery of the explosive type .

The strain to which explosive engines are subjected may be likened to that of an appliance which is revolved by a series of rapid intermittent blows rather than by the comparatively uniform pressure that exists in such a motor as the steam engine. It is probably undeniable that, if the factor of safety of certain parts of explosive engines were doubled when designing such machinery (thereby permitting larger-sized shafts, heavier housings and thicker cylinders to be installed), the efficiency and endurance of such machinery would be greatly promoted.

Experience in the operation and development of submarine boats bears testimony to the fact that a decidedly too small factor of safety is employed in the design of such machines. The shafts are probably too small in diameter to withstand the impulsive heavy shock to which they are subjected and the housings too light for the condition under which the engines are operated. The efficient operation of the submarines for protracted periods will probably never be brought about until the factor of safety of such machinery is increased and heavier engines thereby installed. The installation of considerable additional machinery weights can probably only be effected at the expense of other important features of construction. The general unsatisfactory endurance of such machinery, however, undoubtedly shows that the existing installations are too light for continuous work.

General Observations.

There is no mystery about the design or operation of the modern gas engine that should ultimately prevent its more general adoption for both industrial and marine purposes. The principal hindrrance heretofore to its more extended use has been due to the fact that too many experts have been prone to regard this type of motor as an instrument of precision and as an appliance that required exceptional skill and intelligence in its design, manufacture and operation. The development and more extended use of the gas engine will be effected if its salient principles are made more fully known to engineering students and intelligent mechanics rather than by depending entirely upon the research work and investigation of a comparatively few skilled designers and technical experts for further improvement and efficiency.

* * *

COMPRESSED AIR STORAGE.

THE dangers that may lurk in vessels used for storing compressed air and which are often employed at collieries for operating drills and coal-cutting machines or in connection with the starting of gas engines have been repeatedly called attention to. The danger arises from the fact that air is greatly heated by the work spent upon it during compression, and this tends to promote a process of spontaneous ignition amongst any accumulation of oily deposit which may have collected in the receiver or its connections.

Such deposits are very liable to be formed in an air compressing plant, and are derived from the oil used for lubrication, coupled with carbonaceous dust, e.g., coal dust which often exists in the neighborhood of collieries, and thus gets down into the compressor and is afterwards deposited in the receiver and its connections. This danger is greater than many people using these air receivers think, and the only way of avoiding it is by periodical inspection and scrupulous removal, at proper intervals, of any deposit that may be found.

During the past month, particulars of a disastrous explosion of a vessel of this kind has come under our notice, says Vulcan. The receiver was about 3 ft. in diameter by 10 ft. in length, and made of about 3/8 in. plates. The ends were made of 1/2-in. plates, one of them being dished inwards and the other dished outwards to about the same radius, namely, 3 ft. 6 in. The explosion was destructive, though fortunately unattended with injury to life or limb. It is interesting to note that the end which was dished inwards was the one that was blown out, which supports the view that when a cylindrical vessel subject to internal pressure is fitted with dished ends, it is better for the camber to be so placed that the pressure acts on the concave and not on the convex side; in other words, for the camber to be outwards and not inwards.

* * *

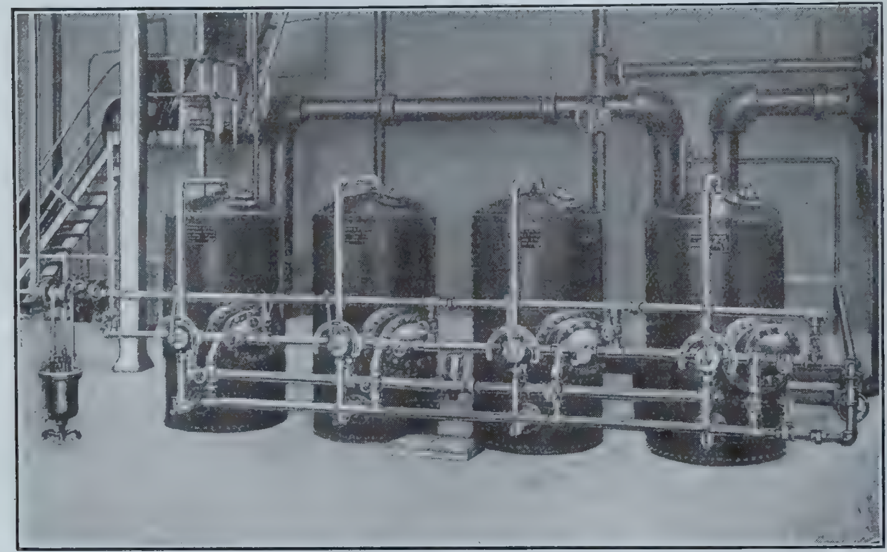
Safety Valves.—All safety valves should be large enough to prevent any considerable increase of pressure whenever the demand for steam ceases. On large stationary boilers it is good practice to have two safety valves; one a spring-loaded valve fitted with an escape pipe, to blow off at the required pressure and the other, an open deadweight valve set to blow off at a slightly higher pressure, both of which may be locked as a precaution against overloading.

REFRIGERATION DEPARTMENT

FILTERS AND THE RAW WATER ICE PLANT.

THE preparation of water in raw water ice plants is probably the most important item in the manufacture of raw water ice, and a question which has been paramount in the minds of those interested.

Experiments have been made from time to time with various filters and filter mediums. Originally the charcoal filter was used, such as is found in distilling plants, but in this filter, although giving satisfactory results at first, the quality of the effluent appeared to deteriorate very rapidly. It seems unusual that the effluent from a filter would freeze a clear cake at first, and then gradually deteriorate. The reason may be traced, however, to the clogging of the bed; the porous charcoal absorbing to a point where further absorption was impossible, and there being probably no adequate means for washing the bed, the filter becomes clogged and useless.



FILTER EQUIPMENT FOR RAW WATER ICE.

The Roberts Filter Mfg. Co., of Darby, Penn., after extensive experiments, have produced the Roberts Multiple Effect Filters, built especially for raw water service, and these we understand are now installed in numerous ice plants throughout the country, and are giving excellent results.

The illustration shows a typical 100-ton plant installation; the tanks of steel being equipped with the Roberts control valve, which controls the entire operation of each filter, namely filtering to service, cleaning, filtering to waste, bypass, and closed valve, from one point. This simplicity of operation is especially advantageous when inexperienced labor is operating the filters. The filters are also equipped with the Roberts interior orifice type strainers. These are tapped in a steel base plate in the filter, and effectively prevent clogging or channeling of the filter bed, while ensuring an even distribution of wash water throughout the bed, which is so essential to good results. The filters are also equipped with the necessary manholes, handholes and central waste with sight glass, and taps on each filter for drawing samples.

The preparation of water for raw water ice is as follows: A coagulant feed tank placed in the influent line feeds a small quantity of coagulant to the water by means of a back pressure valve, as illustrated. A small quantity of alum tends to coagulate the suspended matter in the water so that it may be more readily removed by the filters. After this coagulant is applied, the water passes through the first filter, which removes a large amount of the suspended matter, and then successively through the second, third and fourth filters, where the remaining matter is removed. The filter bed of each unit is composed of 30 inches of high grade silica sand and a 9-inch layer of gravel, the gravel being placed immediately above the strainer system and supporting the sand. The effluent delivered from the fourth filter is a bright, clear, polished water, free from matters in suspension visible to the naked eye, and a water that will freeze a cake of ice without the objectionable brownish arc in the bottom of the core which is so detrimental to the sale of raw water ice. The piping of this installation is such that each filter may be by-passed for cleaning, which insures no interruption in the service.

Experiments were carried on for a period of eighteen months before the filters were put on the market. Solving the problem of the discolored cake is a long step forward in the perfection of raw water ice making.

* * *

MAMMOTH STITCHED COTTON DUCK BELT.

ONE of the largest rolls of stitched cotton duck belting ever made was recently turned out by the Gandy Belting Co., Baltimore, Md. The roll is 712 ft. long, 36 in. wide and weighs 6,000 lbs. The belt is of the maker's standard type and is manufactured of a special weave of heavy weight cotton duck stitched with a heavy sewing cord on patented machines to give an imbedded stitch that leaves the surface of the belt smooth, the stitching being done while the belt is under tension from end to end. A special width of belt was woven in this case, as as is the regular practice of the Gandy Co., to give a selvage and even strain on both edges.

In common with all the belts produced by this company, it was subjected to a special oil process, with a view to rendering it water, oil, steam, heat and dirt proof, as well as keeping it pliable and adding to its life.

* * *

Efficiency in design means a machine in which every part can be made in the quickest and most accurate way by the least skilled men; a machine which will sell itself with the minimum of boosting and which will produce the maximum of accurate work in the factory where it, in turn, will be operated by the cheapest man the owner dares to put on the job.

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Vol. VII. DECEMBER, 1914 No. 12

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"RING OUT THE OLD—RING IN THE NEW."

INTO the lives of none of us, however long or short may have been our sojourn in this Old World, has there at any time been thrust an experience so far-reaching in its effects as that to which we are now subjected. All of us, we dar say, have figuratively speaking, been more or less under fire in the individual or personal sense, and have emerged, scarred it may be from the ordeal. The experience to-day is both collective and individual and altogether universal in its scope. The craft to which we belong and its handiwork are giving evidence of themselves in a manner which while betokening high-degree skill and accomplishment, yet appears to smack strongly of misdirection, in that the bent is destructionwards.

There need be no ground for alarm or uneasiness however on the latter score. The destruction which the engineering fraternity have made possible to-day is preliminary to a redirection of effort and advance tomorrow, and although our civilization has been arrested or has even been given somewhat of a setback, the rebound, when right has again been enthroned and might, the ogre of selfishness, has been swept to the four winds, will be that much more powerful, and its potentialities more pregnant and prolific.

The patronage to which **The Power House** since its establishment has been accustomed increases with each succeeding year and we as its publishers take naturally some little pride in the fact. Our subscribers and advertisers are to be reckoned among the common-sense people of this Dominion, in that they, to a degree unapproached perhaps by any other section of our industrial community, have not only kept on making **Business as Usual** their slogan, but have at the same time given practical demonstration of it. Their spirit shown in these trying days is such as will make 1915 from its dawn onwards the harbinger and bearer of greater opportunity and enlarged appropriation and, needless to say, as in the past, we are ready through the medium of our publication to measure up to every requirement.

The departmental features which during the present year have met with the approbation and commendation of our readers will continue to occupy a large place. In this connection, and in response to numerous inquiries received, we have pleasure in stating that the **Operators' Instruction Course** will be resumed in January, and will contain each month regularly thereafter. Due to unforeseen circumstances we were obliged to omit this feature in our November and December numbers.

The first of a series of articles dealing with the factory power plant from the economy and efficient viewpoint will also appear in January, and on account of the important part that the power feature plays in the manufacture of all or any products, we repeat here the observations already made concerning the forthcoming series. The subject matter will largely consist of a recital of actual existent, uneconomical and inefficient conditions of operation, the steps taken to remedy these, and the success achieved. The information will therefore be so interesting and valuable both to factory managements and their power staffs as to make effective appeal and bring about an improved set of conditions with respect to this important, yet much neglected department of manufacturing enterprise.

It is now in order, and at the same time our privilege to express to the many friends of **The Power House** known and unknown, our hearty and sincere good wishes for a growingly bright and prosperous New Year.

The Operators' Point of View

CONCERNING STEAM TRAPS.

By W. B. Henry.

IN your October issue, J. A. Thorn makes some statements regarding steam traps. He says that "he has found D. G. C. regulating valves to be every bit as good and much cheaper than the traps spoken of by Mr. Benton."

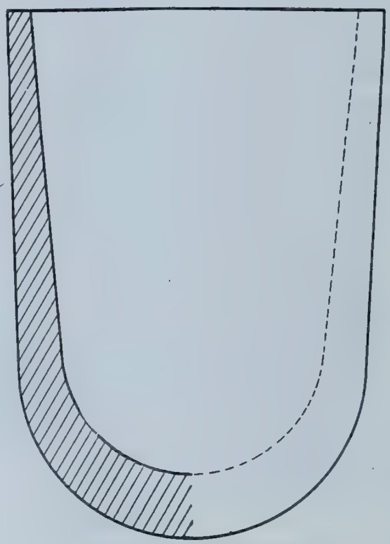
Mr. Benton in his article in September issue, mentioned bucket traps, and while it is not my idea to boost any trap in particular, yet I have a great liking for any trap working on the bucket principle and believe this to be the correct principle of draining condensation from steam spaces. The principle I refer to is that the trap valve is either wide open or shut.

Thermostatic traps, that is those depending upon variation of temperature to cause them to open and close I do not have any use for, and would not use them for steam heating work. A steam trap is connected to a steam line, or radiator to automatically allow the water of condensation to escape from the steam space but not to allow steam to pass: thus it is water we are handling through the trap not temperature, so why try to control the passage of the water by its temperature.

The Operation Feature.

We are all of us agreed on the fact that saturated steam has the same temperature as the water from which it was evaporated: that is steam and water in a boiler are both at the same temperature. Now let us consider the radiator. It contains steam and water. The steam is in a saturated condition and consequently must be practically of the same temperature as the water, so how can there be sufficient difference of temperature between the steam and water in the radiator to make possible that a thermostatic trap will pass water at 240 degs. F., but will close as soon as steam strikes it although the steam is at practically the same temperature.

The only way I can see for a thermostatic trap to work would be that, when a radiator is supplied with steam at a temperature of say 240 degs. F., to have the trap set to close a few degrees below the temperature of the steam, say 236 degs. F. Thus, water of condensation would lodge against the trap until its temperature would fall to say 234 degs. F., thereby causing the trap to open and allow the water to pass. The discharge of the cooler water would be followed by hotter water from the interior of the radiator and just as soon as either water or steam of a temperature of 236 degs. F. got to the trap the latter would close. So long as this radiator was supplied with steam at a constant pressure I believe the thermostatic trap would have a chance to make good; but, the supply of steam to the average heating system varies considerably in pressure, and there is a corresponding variation in its temperature. Thus, suppose the above radiator were for a time, say on a mild day, supplied with steam at atmospheric pressure that would correspond to a temperature of 212 degs. F., or considerably below the temperature at which the trap was set to close, the trap would then remain open and steam would blow past the trap and be wasted. Can anyone persuade themselves to believe that steam at 212 degs. F., will close a thermostatic trap, just because it is steam and not water, in spite of the fact that the trap has been set to close at a temperature of 236 degs. F.



BABBITT MELTING POT.

This is exactly how I have found some thermostatic traps to work. I say some because I have not seen and used them all, and I am not too old to learn, and there may be a thermostatic trap on the market that does work, but so far as my experience goes I have not met one that is satisfactory, and I am much of the same mind as Mr. Bunton, I like a trap that operates on the displacement idea and that is open full when it is open and shut tight when it is shut.

I consider the proper drainage of steam lines and steam heating systems a very important proposition and also believe that one cannot get a steam trap "too good." There are several float traps on the market that work on the displacement principle but many of them have the bad feature of just slightly opening the valve and are of the continual flow style; always drip, dripping, with the accompanying, quick wearing out of the valve and valve seat.

Temperature Not a Factor.

To my mind any steam trap to be completely successful must operate on the quantity of water flowing to it regardless of temperature, that is, when the trap becomes full of water it must open its outlet valve full, and the valve must remain full open until the trapful of water is discharged. The valve must then close and close tight.

There are several makes of bucket traps that work this way, also some makes of float traps and also some traps that have a sort of tumbling receptacle like the "Bundy" steam trap.

Any of these types are so far as my experience goes O.K., but a trap that opens and closes the outlet valve a variable amount, according to the variations of the quantity of water flowing to it, is not to my mind as good a steam trap as the former type.

BABBITT MELTING POT.

By A. L. Loy.

FOR melting babbitt and cyanide, we use a cast iron pot of the shape shown in the sketch, the bottom being thick and rounded, as we find they do not burn out as rapidly either from the inside of from the outside. These pots are 13 in. in height and 9 in. in diameter at the top, with the bottom about 1½ in. thick. They are fitted with handles to correspond to the style of furnace used for heating.

GAS ENGINE MUFFLER EXPLOSION.

By H. Westwood.

BEING an engineer and reading various journals concerning the trade, I very often notice an account of a boiler explosion or fly wheel disaster, but seldom see very much regarding the internal combustion motor. One is apt to think, therefore, that there is very little of this apparatus in operation, yet, from the plants I have visited and read about there is every evidence that the gas engine is here to stay.

What, then, is the matter with the men who operate them, that they do not relate more of their experience concerning the troubles which arise? Are we to believe by their silence that they do not have any trouble? I think the position of the gas engineer is this, that after he has racked his brain for ten hours a day to keep the wheels moving and has put in a few hours overtime fixing igniter plugs, or hunting for trouble, he is satisfied to let the other fellow find such things out for himself.

I recollect some time since going down to the works to get the wheels moving as usual. Having got the producer in operation and making good gas, I made preparation to start the engine. It was a fine summer morning, and we had the windows wide open. The engine stood about four or five feet from the wall between two windows and the muffler was on the outside between the windows. I closed the valve to the atmosphere on the producer, opened the gas valve on the engine, put in the igniter switch, turned on the air and she began to move as usual. She had not made many revolutions, however, before I discovered that I was losing my air pressure owing to the second cylinder failing to explode the gas.

As was usual in such a case, I cut off the air from the first cylinder that had put the engine in motion so that it would start working on gas. It started exploding gas all right. A couple of shots went through the exhaust pipe and then the gravel began coming through the open window to see me. A violent explosion shook the building to such an extent that the time-keeper at the front door fully two hundred feet away felt the jar that occurred.

The muffler was a cast iron box about four feet square by one inch thick, and was laid in the ground so that about six inches of it only projected above. It had a seven-inch steam pipe for an outlet, the latter being about fourteen feet high. It blew the box to bits and threw the pipe about fifteen feet. When I saw the gravel coming in the window, I pulled out the igniter switch, but replaced it again before she had died down; but the noise, oh my! it was I suppose realistic of the North Sea with the fourteen-inch guns at work. Except for the noise, the engine was operating all right, but the question in everybody's mind was the explosion cause.

For the time being I did not know myself exactly what had caused it, but made up my mind to find out. The engine was of the vertical two-cylinder, four-cycle type. She was started with compressed air on one cylinder while the other got working on the gas, and as soon as the speed increased, the air was cut off and this cylinder started working on the gas.

Explosion Cause.

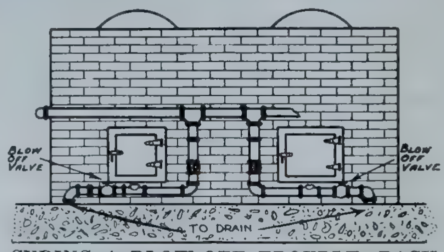
After much time, thought and investigation, I discovered the trouble. On the inlet valve cam shaft were the valve cams, and by their side was the igniter cam. On the end of the shaft was a small air piston that pushed against a ½-inch rod that ran through the centre of the shaft to a feather key that caused the inlet valve cam to stand still while this cylinder was being operated by compressed air. When the air was released a spring at the end of this rod pushed it back and allowed the key to carry the cam around when it came to its proper position.

The igniter cam was made so that if the engine turned backwards it would stand still when the lip of the cam came in contact with the igniter rod, and would not travel forward until the key inside came around and carried it forward. On this occasion, when the engine was started up, the second cylinder failed to explode the gas which was exhausted into the muffler unburnt. Ten or fifteen charges probably went into the latter. On cutting off the air, the inlet valve cam took up its proper position when the key slipped into it, but the igniter cam was carried out of its position by the inlet valve cam taking it along. The consequence was that this cylinder exploded the gas when the exhaust valve was open and, the muffler being full of rich gas, it blew up.

CURING A BLOW-OFF PIPE TROUBLE.

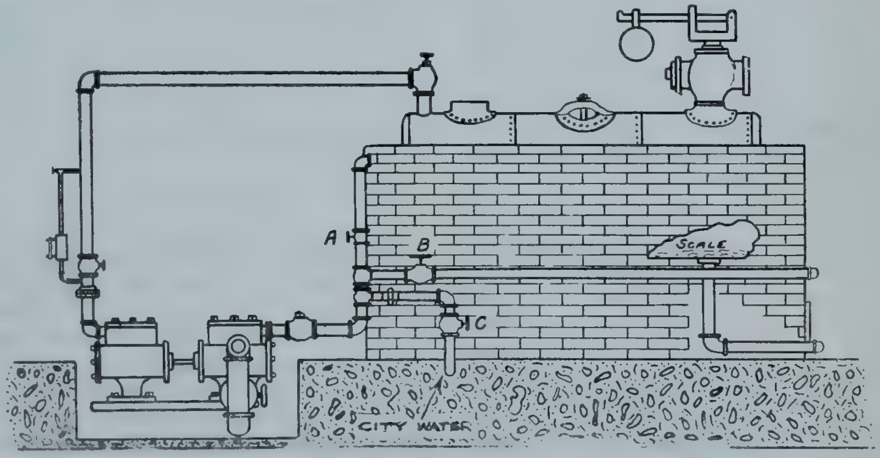
W. H. Rose.

TROUBLE developed from a rather peculiar source in one of the blow-off pipes of a boiler, of which I had charge, following the use of a boiler compound, the instruction concerning which demanded that the boiler be not blown down for a week. At the end of the week I decided to wash out, so opened the blow off valve slowly until it was wide open. The pipe only became moderately warm which went to prove that only a small quantity of water was coming down. I shut off the valve and gave instructions to fire up the other boiler, deciding that it was best to allow the first boiler to cool down.



CURING A BLOW-OFF TROUBLE—BACK VIEW OF BOILER.

After two days had elapsed, I opened up the boiler and got inside. The boiler compound had done its work most satisfactorily. From the point where the feed water discharges between tubes, and on the sides of the boiler, the scale had been loosened in pieces of varying size. Some of these had lodged over the entrance to the blow off pipes, therefore, I had to evolve some plan to rid myself of a repetition of the trouble, and devised the following system: I fitted up my boilers so that the feed water was introduced at the back; thus when I wished to blow down it was only necessary to close one valve and open another and in this way manage to eliminate all troubles in blowing off after using a boiler scale compound.



CURING A BLOW-OFF TROUBLE —SIDE VIEW OF BOILER.

The accompanying sketches serve to illustrate the simple piping which enables one to use either a pump, city water, or injector by shutting valve A and opening valve B, and also opening the valve at the back of the boiler, through which it is wished to feed, just before blowing down. Should the pump not be working, city water could be used by closing valve A and opening valve C, and the same conditions apply when an injector is used. One could feed, if he so desires, from the back, as the water would still be warm when entering the boiler as it passes through the gas chamber.

* * *

RECOVERY OF WASTE OIL.

IN a paper read before the Graduates' Association of the Institution of Mechanical Engineers, G. H. Ayres dealt with methods of recovering waste oils and greases from materials like cotton waste and rags used for cleaning machinery, and for rendering the materials fit for use again. The author said that until recently no process was in existence which could deal with such materials so effectively as to make their reclamation remunerative, but in many cases it is found that the materials which were formerly thrown away after first use are of greater value than the cost of new materials, owing to the oil contained in them.

Oil Extraction.

A convenient machine for extracting the oil is a turbine centrifugal separator. The rags are put in a perforated cage which is rotated at a peripheral speed of 6,000 to 7,000 ft. a minute by means of a steam-turbine incorporated in the machine. Thus no mechanical drive is required, and the exhaust steam from the turbine also serves to heat and liquefy the oil and grease. The separated oil may be filtered and purified in settling tanks, by means of filters of the filter-pad, gravity or similar types, or, when large quantities have to be dealt with, by a turbine centrifugal oil filter, which, like the separator, is self-contained and needs only a supply of steam at a pressure of 20 lbs. per square inch and upwards.

The rags or other materials from which the oil has been extracted are ready for further use as they come from the separator if they have been used only for mopping up oil or for comparatively clean work such as wiping down engines, but if they have been used for dirtier work they require washing. The machine used for this purpose resembles the ordinary laundry washing machine, but it embodies certain special features, such as a sludge chamber at the bottom of the cylinder casing in which the heavy dirt and grit may accumulate, an overflow trough at the horizontal centre line for the removal of suspended matter loosened during the process, and a removable section opposite the ordinary door in the revolving cylinder to permit the casing and sludge chamber to be easily washed out. After being washed, the wet material may be returned to the turbine centrifugal separator or passed on to an ordinary hydro-extractor, the final drying being effected in cabinets or automatic drying machines.

The Lancashire and Yorkshire Railway Co., who discarded cotton waste some years ago, use approximately 6½ millions of sponge cloths annually for cleaning purposes. These cloths, which are soaked with ordinary lubricating heavy cylinder, petroleum, and rape oils, with a small amount of tallow and yellow grease, yield from 1 to 1¼ gallons of crude oil per gross.

Oil Recovery From Metal Turnings.

Waste of oil again occurs when screwings and turnings are thrown upon the scrap-heap after very casual draining by which only about 30 per cent. of the oil is recovered. The loss may be avoided by treating the screwings or turnings in one of the centrifugal machines already described or in a machine specially designed for the purpose. In the latter type the swarf is put into a pressed steel pan which revolves at a high speed about a vertical axis. The oil driven off from the charge is expelled between the top edge of the revolving pan and its cover, and is thrown against the vertical filtering medium, through which it is pressed by centrifugal force.

The economy of this process may be judged from the fact that in the Wolseley motor-car works by means of turbine centrifugal machines, 1,200 gallons of cutting oil are recovered weekly to be used over again, the fresh oil needed to make up wastage being only 10 per cent. of the total amount required. One firm of manufacturers of cycles and cycle parts treated in six months 834 cwt. of metal turnings, 8 cwt. of rags, and 134 gross of sponge cloths, and recovered a total of 2,440 gallons of oil.

* * *

Successful Pump Test.—A bonus of approximately ten thousand dollars will be paid by the City of Toronto to the Turbine Equipment Company on account of the exceptional capacity of the turbine engine and pump they installed a month ago at the John Street pumping station. This apparatus was guaranteed to pump fifteen and a half million gallons of water daily, but since its installation a month ago has been pumping in the neighborhood of twenty-one million gallons steadily.

MONTREAL LODGE NO. 1 C.A.S.E.

ON the evening of Friday, Nov. 27, the Montreal Lodge No. 1, C. A. S. E., had its first smoker. The occasion was a success from start to finish. The program did not have a dull number. In fact the entertainment was so much enjoyed by those present and the encores became so frequent and persistent that the president had to ask the members to kindly refrain from encoring further selections or the complete list could not be presented. The meeting opened with the president, R. D. Smith in the chair, and the entertainment consisted of the following numbers:—

1. Chairman's address.
2. Song—W. H. Barry.
3. Song—Bro. Chas. Stephen.
4. Song—Bro. H. K. Paton.
5. Victrola selections—Bro. P. MacFarlane.
6. Bagpipe selection—Piper Ferrier.
7. Recitation—W. Forsyth
8. Song—W. J. Corbett.
9. Recitation—Bro. A. F. Parker.
10. Song—Bro. Chas. Stephen.
11. Address—H. L. Peiler.
12. Address—F. W. Moore.
13. Address—A. Hawksworth.
14. Song—H. A. Wilson.
15. Address—Bro. A. Kastella.
16. Address—Bro. H. L. Sackett.

In addition to the foregoing, brief impromptu speeches were given by other prominent members of the Montreal lodge.

Montreal, No. 1, C. A. S. E. came into existence in its present lodge rooms at the Royal Arcadian Chambers, 92 Union avenue, on February 27, 1914, and twenty-four charter members were enrolled. This number has increased steadily, and now ninety-one active members are enrolled. It is hoped that the century mark will be passed by the year end.

The smoker on Nov. 27, marked the completion of the first nine months of the life of the lodge. The men behind it are co-operating heartily together with the result that a great amount of good has been done toward the fostering and promoting of educational, professional, and mechanical knowledge.

At the C. A. S. E. convention in Ottawa in July last, three delegates, namely H. L. Saskett, W. G. Forbes, and A. L. Jones, represented the Montreal body, and W. C. Forbes was elected executive conductor. The local office bearers are as follows:—

Past President—H. L. Sackett.
President—R. D. Smith.
Vice-President—W. G. Forbes.
Treasurer—J. Mitchell.
Financial Secretary—W. H. Johnston.
Conductor—I. J. Tait.
Doorkeeper—S. Winter.
Secretary—A. L. Jones.

Question and Answer Series

Question. — What internal pressure would be sufficient to burst a steel sphere whose walls are ⅝ in. thick and its outside diameter is 8 inches? What would be the difference if the diameter were doubled?

Answer.—Inside diameter = 8—1¼= 6¾ = 6.75 in.

Area of inside cross-section, 6.75× 6.75×.7854 = 35.785 sq. in., which is the area upon which the pressure acts .

Area of outer cross-section=8×8× .7854=50.265 sq. in.

Difference=50,265—35.785=14.480 sq. in., which is the area of metal resisting the internal pressure.

The tensile strength of steel is 80,000 pounds per sq .inch. Total resisting power of the shell would be 14.48× 80,000 = 1,158,400 pounds.

The pressure per square inch is

$$\frac{1,158,400}{35.785} = 32,371 \text{ pounds.}$$

If the shell diameter be doubled, the metal area becomes twice as great, while cross-sectional area becomes four times as great.

The internal bursting pressure would, therefore, be four times, or as the square of the diameter.

* * *

Question.—Neglecting friction, what draw-bar pull would be required to move a 2,000-ton train up a 3 per cent. grade?

Answer.—The power in this case moves 100 feet, while the load moves 3 feet vertically. The power multiplied by the distance through which it acts is equal to the load multiplied by the distance through which it acts.

Or 2,000×3 = Force × 100

$$\text{or Force} = \frac{2,000\times 3}{100} = 60 \text{ lbs.}$$

* * *

Question.—A direct acting pump is required to raise water against a head of 200 feet. The plunger is 6 inches, and the steam piston is 8 inches in diameter. Taking friction at 20 per cent. of the load, what steam pressure should be used.

Answer.—Pressure due to head of water = 200×.433 = 86.6 pounds per sq. in.

Total load on plunger = Area×water pressure = 28.274×86.6 = 2448.5.

Adding 20 per cent. for friction, this becomes $\frac{120}{100} \times 2448.5 = 2938.2$ pounds.

Area of steam piston = 8^2×.7854 = 50.266 sq. in.

Steam pressure required = $\frac{2938.2}{50.266}$ = 56.4 pounds per sq. inch. Pressure carried should be about 60 pounds.

* * *

Question.—A pump rod, 2 inches in diameter, is to be changed from steel to gun metal. What size should the brass rod be?

Answer.—Area of 2-inch circle=3.1416 sq. in. Ultimate strength of steel = 60,000, and of gun metal, 32,000 pounds per square inch. Area required, then, is

$$\frac{3.1416\times 60}{32} = 5.89$$

Diameter would be $\sqrt{\left(\frac{5.89}{.7854}\right)} = \sqrt{7.5} =$ 2.74 say, 2½-inch rod.

* * *

Question.—A pneumatic tool clamp is operated with air at 70 pounds. The cylinder is 2 inches in diameter; the stroke is 4 inches; the throw of the cam is ½ inch, and this acts upon a lever whose long arm is 10 inches, and whose short arm is 2 inches. What is the pressure on the tool?

Answer.—Area of piston = 2^2×.7854 =3.1416.

Total pressure=3.1416×70 = 219.912 pounds.

The piston moves 4 inches, while the cam raises ⅝ inch. Pressure on lever then is

$$\frac{219.912\times 4}{.625} = 1407.4 \text{ pounds.}$$

This force operating on the lever would give a pressure on the tool of $\frac{10\times 1407.4}{2}$ = 7,037 pounds, or 3½ tons.

* * *

Question.—What part of an Imperial gallon is a U. S. standard gallon?

Answer.—One Imperial gallon contains 277.274 cubic inches; 1 U. S. standard gallon contains 231 cubic inches.

A U. S. gallon is, therefore $\frac{231}{277.274}$ = .833 of an Imperial gallon.

An Imperial gallon = $\frac{277.274}{231}$ = 1.2, or 1 1-5 U. S. gallons.

* * *

Question. — Suppose the head of a steam hammer weighed 5,000 pounds and had a stroke of 4 ft., and the steam were cut off and exhaust opened at ¼ stroke which gave the hammer a velocity of 60 ft. per sec., what would be the force of the blow if the work were compressed 1 inch?

Answer.—The height to which a body would have to be raised to acquire a falling velocity of 60 ft. per sec. would be

$$h = \frac{v^2}{2g} \text{ or } h = \frac{60\times 60}{2\times 32.16} = 55.97 \text{ ft.}$$

The total force of the blow then would be equal to that of the hammer upon falling 55.97+3=58.97 ft. or force of the blow =

$$\frac{58.9\times 5000\times 12}{7} = 3,543,000 \text{ pounds.}$$

* * *

Question.—What force would be required to punch a one and one-quarter inch hole in a steel plate one inch thick?

Answer.—Ultimate shearing strength is about 20,000 pounds per square inch. Shearing area is equal to the circumference of the hole multiplied by its depth.

Shearing area = 1.25×3.1416×1= 3.927 sq. in.

Force required is 3.927 × 70,000 = 274,890 pounds or about 137½ tons.

* * *

Question.—A driving pulley is 64 inches in diameter, and a driven pulley which runs at 120 revolutions per minute is 2½ feet in diameter. What is the speed of the driving shaft?

Answer.—The r.p.m. of the driver multiplied by its diameter must equal the r.p.m. of the driven multiplied by its diameter.

Speed of driving shaft then is,

$$\frac{120\times30}{64}=56.25 \text{ r.p.m.}$$

* * *

Question.—An emery wheel is to be set up to run at 1,200 r.p.m. The pulleys on the countershaft are 20 and 8 inches in diameter. The pulley on the wheel arbor is 6 inches in diameter and the line shaft runs at 180 r.p.m. What sized pulley should be put on the lineshaft?

Answer— $1{,}200\times6\times8 = 180\times20\times$ diameter of line shaft pulley.
or diameter of lineshaft pulley

$$=\frac{1200\times6\times8}{180\times20}=16 \text{ inches.}$$

* * *

Question.—The pressure on the piston of a steam engine is 30,000 pounds; the length of the stroke is 30 inches, and the distance from the centre line of the connecting rod to the centre of the main bearing is 16 inches. What sized shaft should be used?

Answer.—In this case it is necessary to determine the combined effect of twisting and bending, and reduce both to either bending or twisting moment.

Equivalent bending moment $= Mb + \sqrt{\frac{Mb^2+Mt^2}{2}}$ where Mb = bending moment and Mt = twisting moment.

$Mb = 30{,}000\times16 = 480{,}000$; $Mt = 30{,}000\times\frac{30}{2} = 450{,}000$ equivalent bending moment.

$$\text{Total} = 480{,}000 + \sqrt{\frac{480{,}000^2+450{,}000^2}{2}}$$

$= 480{,}000 + 328{,}975 = 808{,}975$

Formula $= \frac{M}{S} = \frac{I}{c}$, $M = 808{,}975$, $S = 10{,}000$

$I = .049d^4$; $c = \frac{d}{2}$; $\frac{I}{c} = \frac{.049d^4\times2}{d} = .098d^3$

Formula becomes $\frac{M}{S} = .098d^3$ or d^3

$$= \frac{M}{.098S}$$

$$d^3 = \frac{808{,}975}{.098\times10000} = 825.48;\ d = 9.38 \text{ in.}$$

Use in this case 9⅜-inch shaft.

* * *

Question.—Will a pump lift hot water? If not, why?

Answer. — No. Theoretically cold water can be lifted about 34 feet. As the temperature is raised this height is decreased until at or near the boiling point it cannot be lifted at all. The reason is that the hot water easily changes to steam at the lower pressure of the suction and thus steam instead of solid water fills the cylinder of the pump.

* * *

Question.—What is the method of procedure in setting the valves of a duplex pump?

Answer.—First take off steam chest covers and set both rocker arms exactly plumb. Measure carefully the width of steam ports and place both valves centrally over ports. Set up jam nuts to within half the width of the ports from the valves and lock them in this position. Valves should move in opposite directions to open ports. Replace covers and pump is ready to start.

* * *

Question.—A hydraulic wheel press is driven by two eccentrics directly connected to a 20-in. pulley. The diameter of one plunger is ¾ in., and of the other 2 in., and the common stroke is 2 in. If the effective pull on the belt be 90 lbs what pressures could be obtained on the ram with either eccentric?

Answer.—The possible pressure on the plungers is the same as 90 lbs. on a 10 to 2 leverage or

$$\frac{90\times10}{2} = 450 \text{ lbs.}$$

Area of ram $= 10^2\times.7854 = 78.54$ sq. in

Area of small plunger $= 15^2\times.7854 = .4418$ sq. in.

If pressure on plunger were 1 lb., pressure on ram would be

$$\frac{78.54}{.4418} = 177.8$$

Therefore, with belt pull of 40 lbs, pressure on ram is $177.8\times450 = 80{,}010$ lb. or approximately 40 tons.

Area of large plunger is $2^2\times.7854 = 3.1416$ sq. in. 1 lb. pressure on large plunger would give

$$\frac{78.54}{3.1416} = 25 \text{ lb.}$$

With belt pull of 90 lbs. or 450 lbs. on plunger pressure on ram is $25\times450 = 11{,}250$ lbs. or 5.6 tons.

* * *

Question.—If the speed of the driving pulley be 200 r.p.m., what would be the speed of the ram (a) using small plunger only, (b) using both plungers?

Answer.—Speed of small plunger is

$$\frac{200\times2}{12} = 33.33 \text{ ft. per minute.}$$

$$\text{Speed of ram} = \frac{\text{area of plunger}}{\text{area of ram}}\times33.33$$

$$= \frac{.4418}{78.54}\times33.33 = .187 \text{ ft. per min} \ldots (a)$$

With both plungers working at 33.33 ft. per min. speed of ram is

$$\frac{\text{combined area of plungers}}{\text{area of ram}}\times33.33$$

$$= \frac{3.5834}{78.54}\times33.33 = 1.52 \text{ ft per min} \ldots (b)$$

or 8 times as fast.

* * *

Question.—A smoke stack is 96 feet high to the point where the guy wires are attached and the ground ends of the wires are fastened 100 ft. from the base. The strain on one cable is 30,000 pounds. What are its horizontal and vertical components?

Answer.—The hypotenuse of a triangle whose sides are 96 and 100 is $\sqrt{(100^2+96^2)} = 158.24$ ft. The length 158.24 represents the pull of the cable. The vertical component is represented by 96 and the horizontal component by 100.

The horizontal component is then,

$30{,}000 : 158.24 : x : 100$ or x

$$= \frac{30000\times100}{158.24} = 18958.5 \text{ pounds.}$$

The vertical component is,

$$\frac{30000\times96}{158.24} = 18200.2 \text{ pounds.}$$

* * *

Question.—Taking the diameter of the earth as 8000 miles, and that it rotates once in 24 hours, what is the speed in miles per minute of a point at the equator? What would be the speed of a point half way between the equator and the pole?

Answer.—Circumference of earth $= 8000\times3.14165 = 25{,}133.2$ miles. No. of miles per minute

$$= \frac{25133.2}{24\times60} = 17.453 \text{ miles.}$$

The radius of a circle halfway between the equator and the pole $= 4000 \times$ the sign of 45 degrees $= 4000 \times 70711 = 2828.44$ miles. Circumference $= 2828.44\times3.1416 = 8885.827$ miles.

Speed per minute

$$= \frac{8885.827}{24\times60} = 6.1707 \text{ miles.}$$

* * *

Question.—What is the rim speed of a 96-in. pulley when running at 180 r.p.m.?

Answer.—Circumference of pulley $= 8\times3.1416 = 25.133$ ft. Rim speed $=$

$$\frac{25.133\times180}{60} = 75.4 \text{ feet per second.}$$

Arithmetic for the Operator

CAPACITY.

CAPACITY is the extent of room or space occupied within the confines of the **three dimensions;** length, breadth and thickness.

To find the capacity or volume of anything, these three conditions are necessary, as nothing can occupy space with less than three dimensions.

A surface cannot take up room, as it has no thickness.

A circle cannot occupy space, but a disc will have volume as it must have thickness.

In the mensuration of surfaces, the units of area are the sq. in., sq. ft., etc., and in the calculation of volumes or capacity, similar units are necessary.

The unit of volume is usually the cubic inch or the cubic foot, and that of capacity in liquid measure is ordinarily the gallon, which may be subdivided or multiplied to suit the problem in hand.

In Chart 42 is shown a tank, the dimensions being 15 ft. x 8 ft. x 7 ft. What is the volume in cu. ft. and the capacity in U. S. gallons, if one cu. ft. contain 7.48 gallons?

Volume = length $\times$ breadth $\times$ depth $= 15 \times 8 \times 7 = 840$ cu. ft.

Capacity = vol. in cu. ft. $\times\ 7.48 = 840 \times 7.48 = 6283.2$ gallons.

What would be the weight of water if tank were full?

One cu. ft. of water weights nearly 62.5 lbs., then $62.5 \times 840 = 52500$ lb., or 26¼ tons.

If the above tank were emptied from two one-inch pipes in four hours, in what time would it be emptied from a 1¾-in. pipe, friction being neglected?

The areas of circles vary as the squares of their diameters, therefore the time will vary inversely as the area of the openings.

Let x = the required time, then

$$1^2 + 1^2 : 1.75^2 = x : 4, \text{ or}$$

$$x = \frac{(1^2+1^2)\times 4}{1.75^2} = \frac{2\times 4}{1.75\times 1.75} = 2.6 \text{ hrs.},$$

or 2 hrs. 36 min.

A large hollow sphere, Chart 42, 4 ft. in diameter, made of steel, is required to sink half its depth when placed in water; what must be the approximate thickness of the plate?

Volume of sphere $= .5236\ D^3 = .5236 \times 4 \times 4 \times 4 = 33.5104$ cu. ft.

Volume of water displaced $= 33.5104 \div 2 = 16.7552$ cu. ft.

Weight of water displaced = vol. $\times\ 62.5 = 16.7552 \times 62.5 = 1047.2$ lb. = weight of the steel in the sphere.

Volume of steel in sphere = weight $\div\ .28 = 1047.2 \div .28 = 3740$ cu. in.; .28 being the weight of one cu. in. of steel.

Surface area of sphere $= 3.1416\ D^2 = 3.1416\times 4\times 4\times 144 = 7238$ sq. in.

Thicknes of plate $= 3740 \div 7238 = .5167$ in., or approximately ½ inch.

In Chart 43 is shown a cylindrical tank, 7 ft. in diameter, and 10 ft. long, partly filled with oil to a depth of 5 ft.; what is the value of the oil at 8½ cents a U. S. **gallon?**

Area of cylinder end $= .7854\ D^2 = .7854 \times 7^2 = 38.48$ sq. ft.

Volume of cylinder $= A \times l = 38.48 \times 10 = 384.8$ cu. ft.

For length of chord g h, we have

$$e\ c : c\ g = c\ g : c\ f, \text{ or}$$

$$c\ g = \sqrt{(ec \times cf)} = \sqrt{2\times 5}$$

$= \sqrt{10} = 3.162$, then chord g h $= 3.162 \times 2 = 6.324$ ft.

$$\text{Sine of angle c o g} = \frac{c\,g}{o\,g} = \frac{3.162}{3.5} =$$

.90343.

Corresponding angle = 64° 37′.

Area of sector e g o h : A = ang. g o h : 360.

Area of sector : 38.48 = 129.25 : 360

$$\text{or a} = \frac{38.48\times 129.25}{360} = 13.81 \text{ sq. ft.}$$

$$\text{Area of triangle g o h c} = \frac{g\,h\times c\,o}{2} = \frac{3.162\times 1.5}{2} = 2.37 \text{ sq. ft.}$$

Area of segment e g c h = 13.81 sq. ft. — 2.37 sq. ft. = 11.44 sq. ft.

Area of end of contents = 38.48 — 11.44 = 27.04 sq. ft.

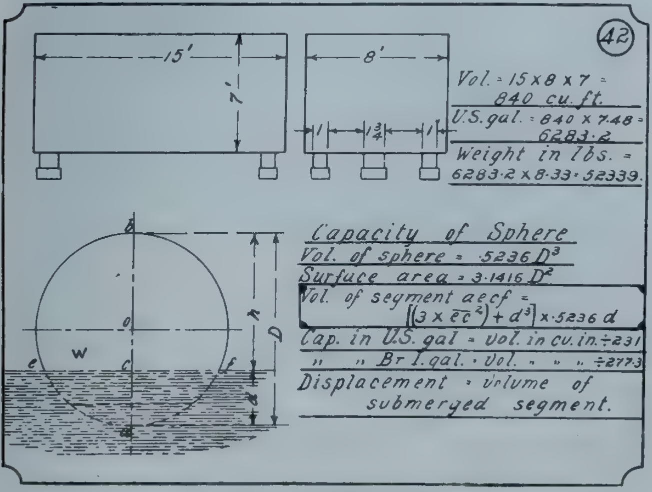
Vol. of contents $= 27.04 \times 10 = 270.4$ cu. ft.

Capacity in U. S. gals. = vol. in cu. ft. $\times\ 7.48 = 270.4 \times 7.48 = 2022.6$ gallons.

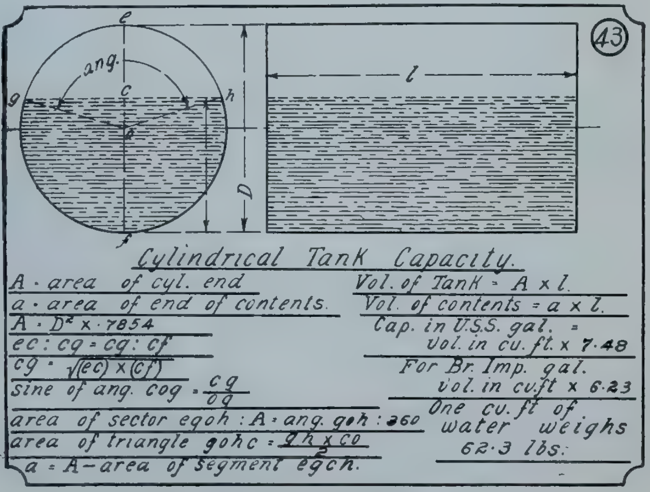
Value $= 8.5 \times 2022.6 = \$171.92$.

If resold at $3.50 a barrel, what would be the profit?

A bbl. contains 31½ gal., and num-


42
15′
7′
8′
1′
1¾′
1′
Vol. = 15 x 8 x 7 = 840 cu. ft.
U.S. gal. = 840 x 7.48 = 6283.2
Weight in lbs. = 6283.2 x 8.33 = 52339.
b
o
w
e
c
f
a
h
d
D
Capacity of Sphere
Vol. of sphere = .5236 D³
Surface area = 3.1416 D²
Vol. of segment aecf = [(3 x ec²) + d³] x .5236 d
Cap. in U.S. gal = vol. in cu. in. ÷ 231
" " Br I. gal. = Vol. " " " ÷ 277.3
Displacement = volume of submerged segment.

ARITHMETIC CHART 42.


43
e
ang.
c
g
h
o
f
D
l
Cylindrical Tank Capacity.
A = area of cyl. end
a = area of end of contents.
A = D² x .7854
ec : cg = cg : cf
cg = √(ec) x (cf)
sine of ang. cog = cg/og
area of sector egoh : A = ang. goh : 360
area of triangle gohc = gh x co / 2
a = A − area of segment egch.
Vol. of Tank = A x l.
Vol. of contents = a x l.
Cap. in U.S.S. gal. = vol. in cu. ft. x 7.48
For Br. Imp. gal. vol. in cu. ft x 6.23
One cu. ft of water weighs 62.3 lbs.

ARITHMETIC CHART 43.

ber of bbls. = 2022.6 ÷ 31.5 = 64.2.

Selling price = $3.50×64.2 = $224.70.

Profit = $224.70—$171.92 = $52.78.

Chart 44 shows the ratio of volumes between similar shaped solids.

The volume varies as the cube of their sides or diameters, or $v : V = s^3 : S^3$.

A large cube of lead measuring 14 inches a side is reduced to a molten state and cast into small cubes 1⅜ in. square. How many will be cast, allowing a loss of ½ per cent.?

By formula, $v : V = s^3 : S^3$. Let x = desired quantity + loss, then

$$x = \frac{S^3}{s^3} = \frac{14^3}{1.375^3} = 1451.8.$$

Number cast = 1451.8×.995 = 1444.5.

If a number 1 in., 2 in., 3 in. 4 in., 5 in. and 6 in. spheres were united and made into one large sphere, what would be its diameter?

By formula Chart 44, D = cube root of $(d^3+d^3_2+d^3_3+d^3_4+d^3_5+d^3_6)$ = cube root of $(1^3+2^3+3^3+4^3+5^3+6^3)$ = cube root of 441 = 7.59 in. dia.

If cast into balls of 1¼ in. diameter, what would be the number?

$$x : 1 = 7.59^3 : 1.25^3, \text{ or } x = \frac{7.59^3}{1.25^3}$$

= 223.7 balls of 1¼ in. dia.

A billet of steel 5 inches in dia. and 14 inches long is heated and rolled into a 1¼-in. round bar. What will be the length, allowing a loss of 2%?

By formula $L : l = 1\frac{1}{4}^2 : 5^2$, where L = length of billet and l = length of bar + loss, then

$$l = \frac{5^2 \times 14}{1.25^2} = 224 \text{ in. or 18 ft. 8 in.}$$

Length of bar = 18 ft. 8 in. × .98 = 18 ft. 4 in., nearly.

In Chart 45 is shown a number of sketches where the area of two or more openings are made to equal that of one large opening or vice versa.

In a heating system, the large pipe with diameter D, Fig. 1, is required to branch off with three pipes of equal size, the three having the same total area as the large one. If the large pipe has a dia. of 16 in., what must be the dia. of the small openings?

By formula:

$$D = \sqrt{(d^2+d^2+d^2)} = \sqrt{3d^2},$$

$$D = 3d^2,\ d^2 = \frac{D^2}{3},$$

$$d = \sqrt{\frac{D^2}{3}} = \sqrt{\frac{16^2}{3}} = \sqrt{85.3} = 9.23 \text{ in.,}$$

or 9¼ inches.

In the branch piece, Fig. 2, Chart 45, the large diameter D is 20 in., and one of the smaller ones 16 in. diameter. What must be the diameter of the second branch so that the two branches d and d will have the same total area as the main pipe D?

By formula:

$D = \sqrt{(d^2+d^2)}$, or $d = \sqrt{(D^2-d^2)} = \sqrt{(20^2-16^2)} = \sqrt{(400-256)} = \sqrt{144} =$ 12 in. diameter.

In Fig. 3 is shown a round pipe branching off into two equal ones of the shape shown. If the diameter D be 12 inches and the dia. d needs be 6 in., what will be the length l so that the two branch areas will total the same as the main pipe D?

Suppose that the two branches were of circular form, then by formula:

$$D = \sqrt{d^2+d^2}, \text{ or}$$

$$d = \sqrt{\frac{D^2}{2}} = \sqrt{\frac{12^2}{2}} = \sqrt{72} = 8.485 \text{ in.,}$$

but as the width must only be 6 inches, we must resolve this dimension, 8.485 in. into two others, one of a circle (or two semi-circles) of 6 in. diameter and a parallelogram, one dimension being 6 in.

Area of circle whose dia. is 8.485 in. = $8.485^2 \times .7854$ = 56.545 sq. in.

Area of 6 in. circle = $6^2 \times .7854$ = 28.274 sq. in.

Area of parallelogram between the two semicircular ends = 56.545—28.274 = 28.271 sq. in.

Flat side of opening = 28.271 ÷ 6 = 4.712 in., then length l = 6 + 4.712 = 10.712 inches.

* * *

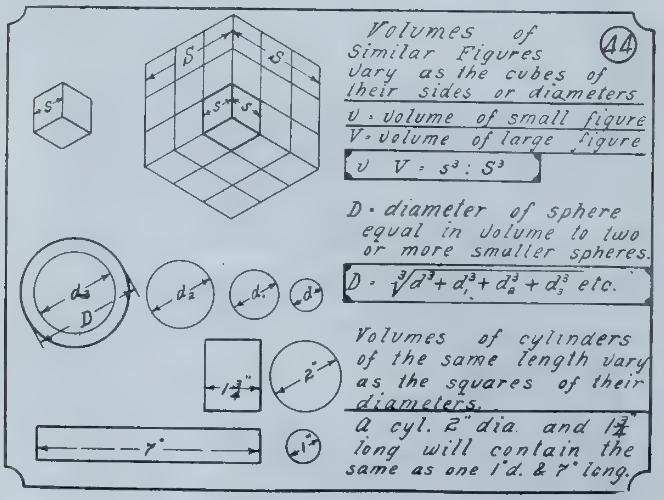
READERS' QUERIES.

Question.—A pipe six inches in diameter and 100 feet high is full of water and closed at both top and bottom. What pressure per square inch would be produced on the outside of the pipe at the top by opening it at the bottom? Could the vacuum pressure be equal to the static weight of the water which, in this case, would be 43.4 pounds per square inch?—A. C. Rioux, Clavesholm, Alta.

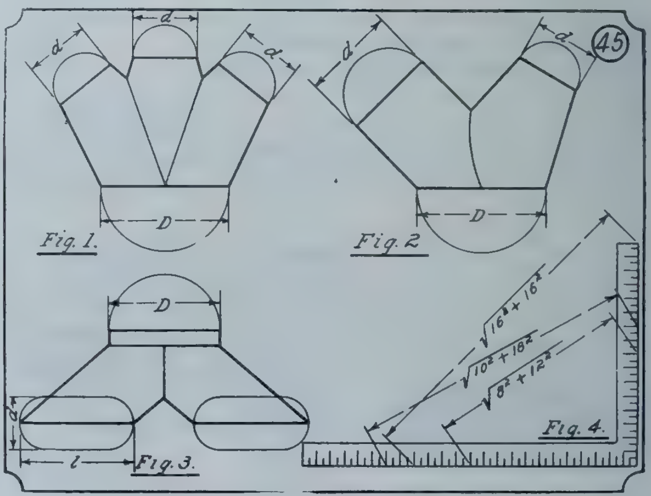
Answer.—Taking for granted that no air is allowed to enter the pipe when the bottom is opend, the external pressure would depend upon the hight of the barometer or the atmospheric pressure which varies according to the altitude of the place at which experiment is carried out.

At the sea level the average barometer reading is 30 inches which corresponds to an atmospheric pressure of 14.701 pounds per square inch. Upon opening the bottom, the water would fall in the pipe until the weight of the remaining water would exactly equal the pressure of the atmosphere; that is, it would stand at 33.9095 feet. The upper 66.05 feet of pipe would be subjected to the atmospheric pressure of 14.701 pounds per square inch which would tend to collapse it.

In the province of Alberta, the average height of the barometer is about 26.3 inches, which corresponds to an atmospheric pressure of 12.926 pounds per square inch. The water in this case, would fall to a height of 29.853 feet. The space in the upper 70.147 feet would be practically a vacuum and would therefore be subject to an external pressure of 12.926 pounds per square inch.


Volumes of Similar Figures Vary as the cubes of their sides or diameters
v = volume of small figure
V = volume of large figure
v V = s³ : S³
D = diameter of sphere equal in volume to two or more smaller spheres.
D = ∛d³ + d₁³ + d₂³ + d₃³ etc.
Volumes of cylinders of the same length vary as the squares of their diameters.
a cyl. 2" dia. and 1¾" long will contain the same as one 1"d. & 7" long.
44
S
S
s
s
s
d
d₁
d₂
d₃
D
1¾"
2"
7"
1"

ARITHMETIC CHART 44.



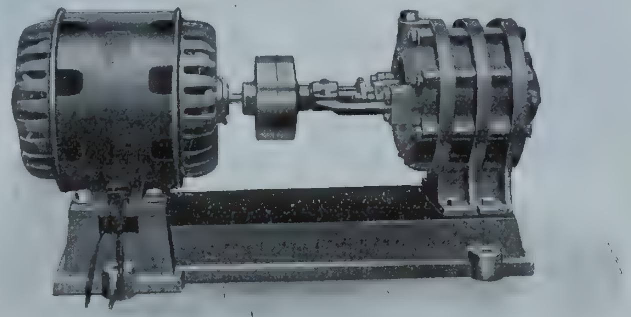
ARITHMETIC CHART 45.

Progress in New Equipment

MULTI-STAGE, MOTOR-DRIVEN CENTRIFUGAL PUMP.

THE accompanying illustration shows a three-stage centrifugal pump, of quite small capacity, built for a head of 150 ft., and driven by electric motor. The pump is equipped with closed impellers, of bronze, polished all over. The case is of cast iron. The coupling is of the flexible type, and the design is such as to eliminate end thrust, as well as give smoothness of operation, combined with noiselessness.

The Smart-Turner Machine Co., Hamilton, are manufacturers of this product.



MULTI-STAGE MOTOR-DRIVEN, CENTRIFUGAL PUMP.

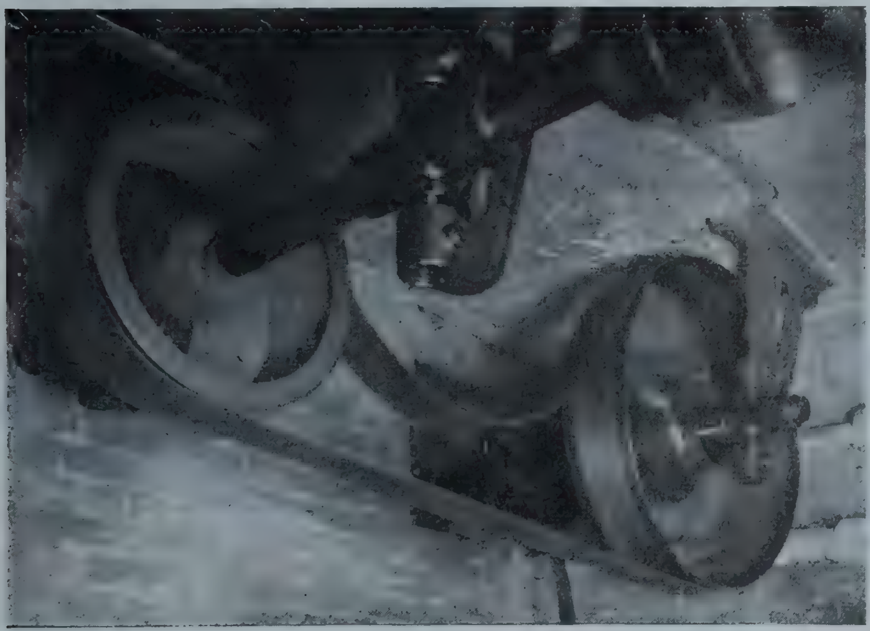
* * *

AN EXCELLENT EXAMPLE OF SLACK BELT.

THAT real slack belts on short centres are quite practical is conclusively proved by the accompanying cut, which shows a 5-inch single leather belt transmitting power from a 15-in to a 33-in. pulley. The distance, centre to centre of shafts, is only 5 feet, and the speed of the driving pulley is 500 r.p.m. This belt, operating in the engine room of the Lambeth Public Baths, Kennington Road, S.E., England, drives two 36-in. towel washing machines, one 36-in. fan, one 36-in. rolled mangle, and one 38-in. hydro-extractor.

Before treatment, great difficulty was experienced in keeping the belt on the pulleys even with much tension, and the latter caused the bearings to overheat, a trouble that was enhanced by the high temperature in the engine room—100 deg. F. at the time the photograph was taken. The exceptional slack now made possible has permitted the removal of all initial tension except that due to the weight of the belt and has been the means, we are assured, of a 25 per cent. increase in the pulley contact areas.

We are indebted to the Cling-Surface Co., Buffalo, N.Y., for the foregoing data and illustration.



AN EXCELLENT EXAMPLE OF A SLACK BELT.

* * *

ELECTRICALLY DRIVEN BOILER FEED PUMPS.

MANY of the best American engineers hold that electrically driven boiler feed water pumps, air pumps, exciters, and circulating water pumps are not advisable in a power plant from any point of view, as they form a link in the chain and any one of these links may be the means of shutting down the entire system. Investment, thermal efficiency, and reliability all indicate steam-driven auxiliaries for power plants.

There is a tendency, however, to use electrically driven apparatus for regular operation with duplicate steam-driven apparatus in reserve. This does not apply to all the auxiliary machines. The feed-water pumps and others in the more modern stations are usually driven by small steam turbines, the exhaust from which is used in heating the feed water. Motor generator sets are used for supplying excitation to the main generators, turbine-driven exciters being held in reserve. The circulating water pumps are also sometimes electrically driven.

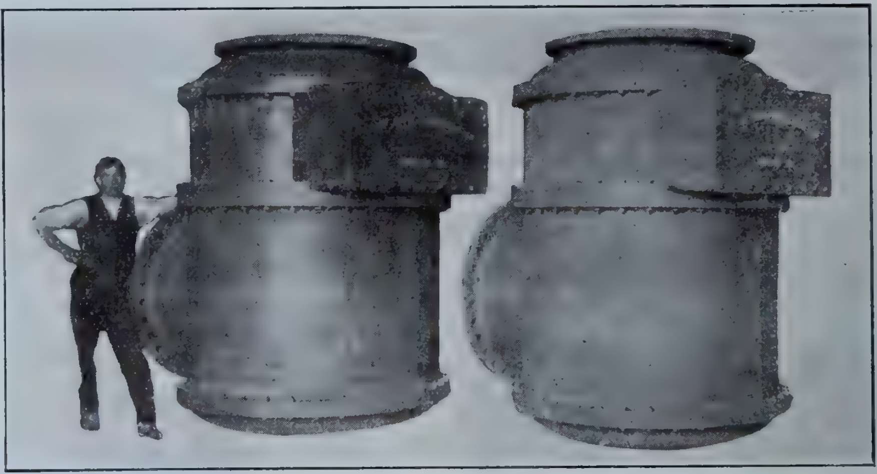
* * *

36-IN. EXHAUST RELIEF VALVES.

THE accompanying illustration shows two 36-in. exhaust relief valves of special design, made by the G. M. Davis Regulator Co., Chicago, for the Edison Illuminating Co., Detroit. They will be installed at Connors Creek Power House No. 1, in connection with the condensing apparatus of 20,000 k.w. turbines.

These valves have horizontal inlets and vertical upward discharge; are 7½ feet high and weigh 9,000 pounds each. Provision is made to operate the valves hydraulically. There is a dash pot with metal ring packed plunger in the lower cover, while a stem connects the plunger and disc.

When in operation, the hydraulic pressure under the plunger will be slightly less than the vacuum holding the disc to its seat, and when the vacuum is lost, the valve will open and relieve to the atmosphere without any accumulation of pressure in the condenser. The discs are water sealed to prevent air leakages, and all the internal parts may be removed through the opening in the body above the disc, without interferring with the pipe lines.

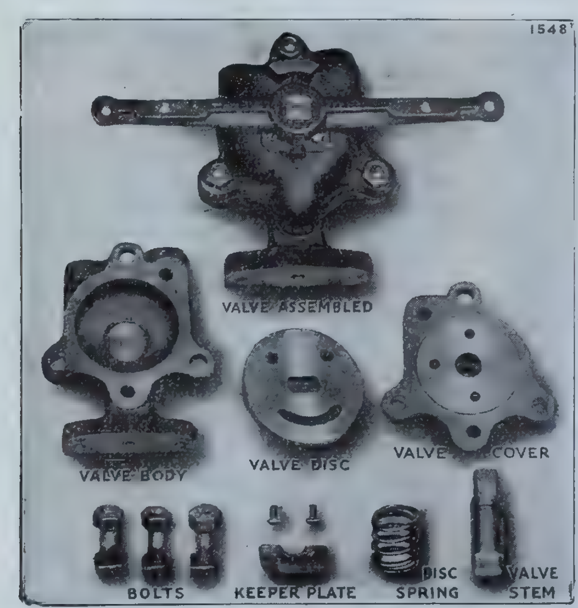

TWO 36-INCH EXHAUST RELIEF VALVES.

* * *

NEW TYPE OF AIR HOIST VALVE.

EVERY user of air hoists knows the importance of a good valve. A poor valve means poor control. Air hoists, especially in the foundry, receive exceedingly hard service, resulting in leaky valves if not designed properly. With this in mind, the Whiting Foundry Equipment Co., Harvey, Ill., has recently developed a disc valve. Based on years of experience and observation in the manufacture and operation of air hoists, it has naturally proved very satisfactory in actual service.

The cut herewith shows all parts and also the valve assembled. Working parts consist of a brass disc operating on a cast iron body, the disc being held in place by air pressure and also by coil spring. The valve seat and disc are both ground, insuring an air-tight joint. The valve lever moves through an arc of 45° each way from the central position, making a total movement of 90°. The valve is so designed that the stem does not pass through the air chamber, thus eliminating leakage at this point. The valve cover and disc may be removed without disconnecting the piping, and no packing is used in the valve.

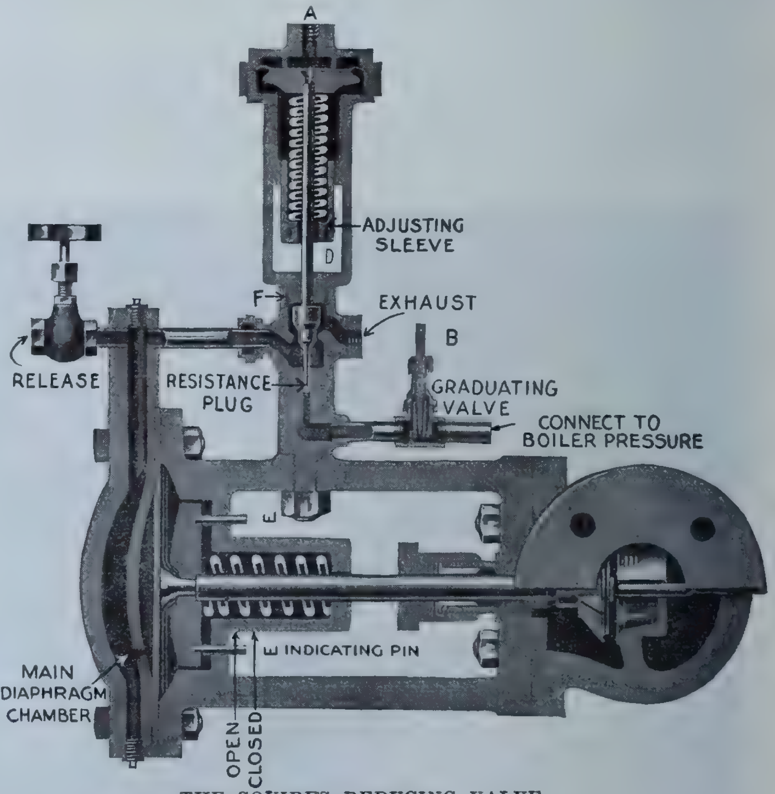


NEW TYPE OF AIR HOIST VALVE.

THE SQUIRES REDUCING VALVE.

THE Squires reducing valve, illustrated herewith, has been designed to fulfil any and all conditions required of such an apparatus. The wearing parts are reduced to a minimum, while the valve seats and discs are removable and accessible without disconnecting the body of the valve from the pipe line, by simply undoing the yoke. The valve has a bypass within itself, and by closing the steam inlet valve to the pilot and opening the release valve on the diaphragm chamber, the unit is wide open and bypassed. The main valve is operated by the initial pressure, and as 25 pounds is all that is necessary to entirely close it, there is a reserve that will positively insure against any danger of non-closing through corrosion or a tightly-packed stuffing box.

As shown by the cut, this reducing valve is controlled by a pilot valve and governed by the low pressure side; consequently the delivery pressure is independent of the high pressure side. The inlet to the pilot valve is piped to the high pressure side of the shut-off valve in the line where pressure is to be reduced. Outlet A at top of pilot valve is connected to reduced pressure side. By means of the interchangeable pilot



THE SQUIRES REDUCING VALVE.

Are Your Boilers Safe?

Many serious boiler explosions have occurred shortly after an Inspector had reported them in good condition. A superficial inspection is worse than none. It is the duty of every steam plant Manager to know the real condition of his boilers.

Scale is responsible for more boiler accidents than all other causes combined, and when its presence is discovered, don't try experiments with patent compound nostrums which require months to learn results, but put a good mechanical Cleaner on the job, that will show immediate results.

A LIBERTY TUBE CLEANER

will remove all the scale in record time, and at a low cost of upkeep. The hard proposition on which other makes of Cleaners have fallen down are what we are looking for.

Write for Catalogue.

Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:

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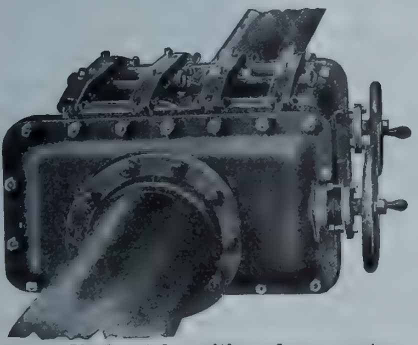
Let the ELLIOTT TWINS Do It

The only DIRECT FLOW Strainer built that gives continuous service.



Horizontal position, doors on top.

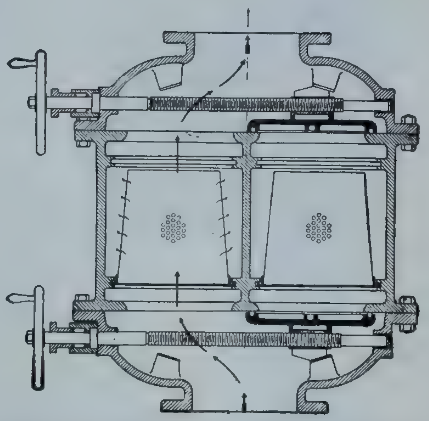
Do your condenser tubes become clogged with rubbish?

Do your pump valves get stopped up, cut out, need constant attention?

Do you have trouble with any of your water handling machinery, on account of the leaves, sticks, grass, etc., in your service water?

The TWIN STRAINER is the best remedy for such troubles. The thousands of them in use to-day is the best evidence we have of their satisfactory service.

DESIGNED TO PROTECT—BUILT TO LAST.
Our Bulletin No. A is yours for the asking.



Section showing the two-basket, two-valve combination. One basket always in service—straight unobstructed flow—simple wear-proof valves—easy access.

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Manufacturers of Filters and Grease Extractors, Separators, Blow-off Valves, Feed Water Heaters and General Power Accessories.

CANADIAN REPRESENTATIVES:
A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

valves, any boiler pressure may be reduced to any lower pressure in one reduction. The operation of the valve is as follows:

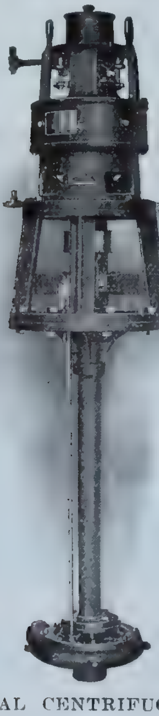
Reduced pressure acting on the diaphragm of the pilot valve is balanced by the tension of the spring, which tension is varied by an adjusting nut. If reduced pressure overcome the spring, the pilot valve is seated, steam seeps past the plug of the pilot valve, thereby increasing the pressure on the main diaphragm and decreasing the main valve opening. If reduced pressure be overcome by the spring, the pilot valve is lifted off the seat, and the exhaust port is opened; pressure is reduced on main diaphragm and main valve opens up, allowing more steam to enter the reduced pressure side. There will always be a slight exhaust from the pilot valve, showing that the valve is just off its seat, and a steady pressure maintained on the main diaphragm holds the valve open just enough to maintain the pressure desired.

We are indebted to the Canadian Allis-Chalmers Co., Toronto, for the illustration accompanying this article.

◆

VERTICAL CENTRIFUGAL PUMP.

THE accompanying illustration shows a vertical centrifugal pump, built by the Smart-Turner Machine Co., Hamilton, Ont., for use in office buildings, and other places where the basement is below the sewer. They build this design of pump direct connected by flexible coupling to electric motor, for handling either sewage or drips which come to these low places. The equipment consists of a specially designed centrifugal pump; a vertical motor direct connected by flexible coupling; a float; a float switch; and where necessary an automatic starter. The cast iron floor plate is made of such diameter as to cover either a cement catch-basin or a cast iron tank. The apparatus is built for direct and alternating current, and makes a compact and convenient arrangement.



VERTICAL CENTRIFUGAL PUMP.

◆

Trade Gossip

The Federal Engineering Co., Montreal, has been awarded a contract for a number of electric heaters by the Cedar Rapids Power Co.

McDonald Hydro-Electric Heating Co. has been licensed at Toronto, Ont., with a capital of $600,000 to carry on business in the Province of Ontario.

The Canadian Westinghouse Co., Hamilton, Ont., has been awarded the contract to supply London and St. Thomas with electrical equipment to cost $40,000.

Harry Newman, in charge of city sales department of the Montreal office of the Canadian Fairbanks-Morse Co., is making satisfactory progress towards recorevry after an operation for appendicitis recently.

Catalogues

Electric Fittings.—A data book of new fixtures and fittings for multiple "Mazda" lamps is being distributed by the Canadian General Electric Co., Toronto. The contents consist principally of particulars covering lamp accessories and price schedules. A number of reflectors are illustrated, accompanied by candle power diagrams.

Liberty Tube Cleaners are described in a bulletin issued by the Liberty Mfg. Co., Pittsburg, Pa. The various styles of tube cleaner are illustrated and accompanied by a description and suggestions for use. The reader is referred to bulletin No. 70 for more complete information regarding the utility of the "Liberty" tube cleaners.

Central Station Power in Coal Mines is the title of bulletin No. 3002-A, published by the Westinghouse Electric & Mfg. Co., Pittsburg, Pa. The bulletin deals with power equipment for coal mines and discusses at length the difference in costs between a mine with its own plant and one where central station energy is used. For the sake of comparison, a typical installation is taken and the power obtained from each unit with approximate costs is set forth in detail. The various items are arranged in a series of tables while the illustrations show various installations and a number of typical load curves.

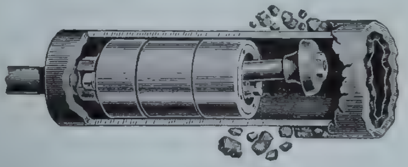
Permutit Process for softening hard water is described in a catalogue issued by the Permutit Company, New York. The claims for this process for softening water and removing iron, etc., are set forth fully; also its application to various industries where the use of soft water is essential in manufacturing. The illustrations show a number of installations. Copies may be obtained from the company's local agent, W. M. Campbell, 25 Howland Avenue, Toronto.

Worm Gearings.—An attractive catalogue, No. 5, containing 110 pages, is the medium through which the Hindley Gear Co., Philadelphia, Pa., feature their products. A complete list of Hindley worm and spiral gears occupies the greater part of the catalogue, the balance being devoted to housings for worm gears, bevel and spur gears. The lists give the essential dimensions for each size of worm and wheel for the various leads, while illustrations show each type of gear. Other views show worm gears used for special purposes, and are included to feature their wide application.

Flanged Pipes and Accessories.—The R. E. Cleaton Co., Montreal, Canadian agents for Aiton & Co., Derby, England, have prepared a neat and attractive catalogue of Flanged Pipes and Accessories. The catalogue contains a number of very complete tables of flow of water through cast iron pipes, and of the flow of steam through pipes. Further tables give the measurement of elbows, tees and various other irregular cast iron pipe connections. Wrought steel pipes, expansion bends, steam separators, etc., are also dealt with. Hanger brackets, roller supports, and wrought iron pipe slings are illustrated, together with various other apparatus for suspending and supporting pipes. Exhaust relief valves and the Aiton steam trap are described and illustrated.

Dixon's Boiler Graphite.—A barrel of Dixon's boiler graphite in the form of a mailing card is what the Joseph Dixon Crucible Co. of Jersey City, N.J., is using to introduce this product to engineers and others interested in cleaner boilers. The card is printed in two colors, and on the inside calls attention to the fact that for nearly four-score-and-ten years the company has had at its command all forms and grades of graphite, and, therefore, has no incentive to use or recommend other than the correct grade of Dixon's boiler graphite. D. B. G. is said to reduce fuel consumption, prevent the hardening of scale, give to the surface of the boilers a smooth polish, prevent pitting and make the removal of scale easy by a gentle,

The Dean removing scale from the tube of a Water Tube Boiler.



The Dean removing scale from the tube of a Return Tubular Boiler.

Scale Removal Made Easy

Cleaning a boiler is the hardest, nastiest job an engineer has to do.
It is usually done on Sundays or Holidays, when other people are at rest or play.

The Dean Boiler Tube Cleaner

makes the job easy. It cleans 10 to 30 tubes an hour. The same cleaner with a change of vibrators or hammers will clean both water tube and fire tube boilers.

The DEAN does its work by vibration—that means thoroughness of work.

Even if you are only remotely interested in the subject of boiler scale, write for booklet No. 130

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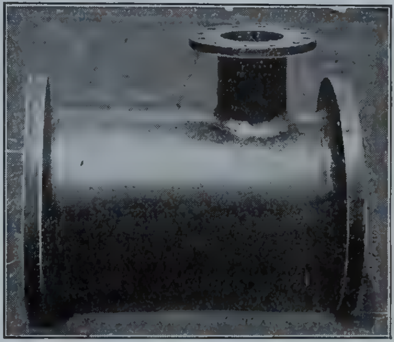
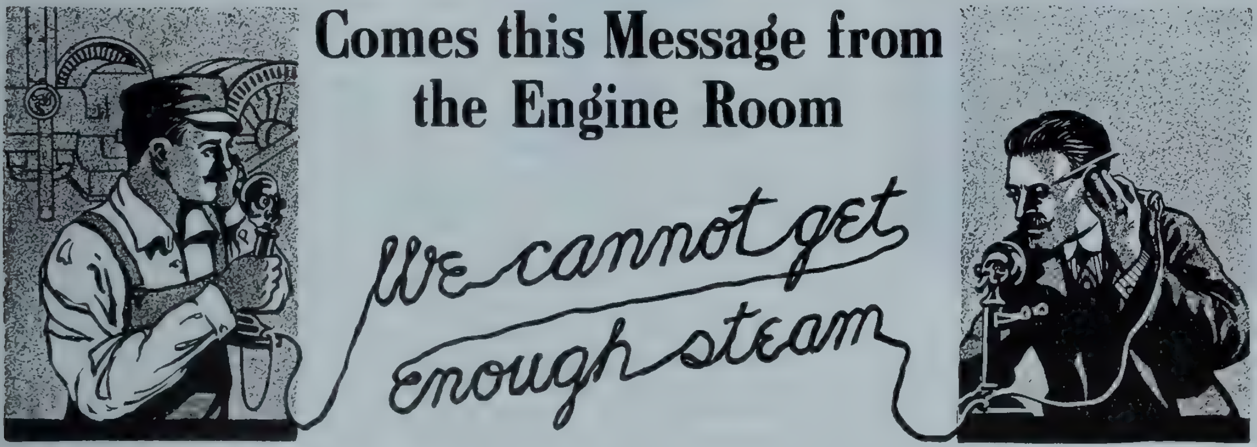


Fig. 2.—18-in. Steam-Pipe Tee with Flanges and Branch Welded on Electrically.



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Do you ever get this message from your engineer when he finds he cannot carry the load over the peak? It's a crisis that may come to you any day—a crisis that can be avoided by installing a

Sturtevant Turbo Undergrate Blower

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The Sturtevant gives all the draft needed—it helps hopelessly overloaded boilers — it gives additional height to stacks that are too short—it gets up steam quickly.

Have one in your plant and save the installation of new boilers.

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mechanical action. The reverse fold forms a return card bearing an invitation to write for the Dixon booklet, "Graphite for the Boiler."

Power Transmission Machinery.—The Hill Clutch Co., Cleveland, O., have recently issued a new and enlarged general catalogue, No. 11, illustrating and describing their complete line of power transmission machinery for belt and drive. Among the principal lines featured may be mentioned the Smith type, Hill friction clutches, and Hill collar oiling bearings. Considerable space is devoted to a description of these lines, and price lists are also included. Other machinery, more or less of standard design, is described and tables give the principal sizes, code words, etc. A useful feature of this catalogue is the amount of valuable information given in the form of engineering notes and mechanical tables, which will be useful in solving transmission problems. A complete index and general cipher code are included, and the catalogue is fully illustrated. The catalogue contains 224 pages, and is bound in substantial cloth covers.

Book Reviews

A Study of the Oxidation of Coal, by H. C. Porter and O. C. Ralston, is the title of technical paper No. 65, issued by the Bureau of Mines, Department of the Interior, Washington, D.C. The rate of oxidation of combustible material during the period preceding ignition is stated to be one of the factors determining ease of ignition, and, in view of the varied and important manifestations of this property in connection with the mining and utilization of fuel, the subject has been given special study by the Bureau of Mines in its investigations relating to fuels belonging to or for the use of the United States. This investigation is dealt with in this bulletin, in which also is included a number of curves and table containing data obtained during the various tests, etc.

Electric Light Fittings, by S. C. Batstone, A.M.I.E.E., 315 pages, 7¼ x 4½ ins., 238 illustrations and diagrams. Published by Whittaker & Co., London and New York. Price, $1.25 net. This is a treatise on wiring for lighting, heating and other domestic uses to which electricity can be applied, and the laying down of small private installations. The author states that his chief aim has been to adhere strictly to the practical side of the question, and has endeavored to make all explanations easy to follow, and diagrams clear and easy to understand. The book is written primarily for students and young electricians, with a view to assisting them in their studies and in overcoming difficulties constantly met with in everyday practice. This volume contains twelve chapters, which cover the subject in a complete manner. The following is a brief resume of subjects dealt with:—Conductors, conduits, switches, cut-outs, ceiling roses, wall plugs and accessories, etc.; lamps, fittings, transformers and circuits, etc.; meters, private plants, and supply stations. Each subject is treated in a clearly expressed and practical manner, without any abstruse theoretical calculations. The illustrations are numerous, and will be of considerable assistance to the reader in obtaining an intelligent understanding of the text. Several useful diagrams and tables are also included. In the appendix are the wiring rules of the Institution of Electrical Engineers and the British Home Office. In addition to the table of contents and general index, there is an index to illustrations and also for the wiring rules, making it a very useful feature. A great deal of effort has apparently been expended in the compilation of this book, which will be a great help to those for whom it has been written.

Practical Lessons in Electricity, by Robert A. Millikan, Francis B. Crocker and John Mills; 320 pages, 8¼ in. x 5 in.; 75 illustrations and diagrams. Published by the American Technical Society, Chicago, Ill. Price, $1.50. This volume is one of a series of practical handbooks for home study published by the above society with the hope that the book will not only satisfy a demand for elementary presentation on the subject, but that it may lead to a greater appreciation of this science of electricity. Broadly speaking, the book is a simple presentation of fundamental electrical principles and their application of direct and alternating-current problems. It would, of course, be impossible to cover the whole field exhaustively in a volume of this size, but it is possible to deal with the subject by means of a survey of rudimentary principles. This has been the aim of the authors in compiling the book which, while dealing with the elementary principles in a simple yet comprehensive manner, also touches on a few particular applications to the field of direct and alternating currents. One aim has been to provide a volume adapted for the purposes of self-instruction, while at the same time a manual of information for the experienced electrical worker. The accomplishment of this object has been aided considerably by the free use of diagrams and illustrations as well as by the use of simple language and mathematics. The volume is divided into four sections or parts, each being independent of the other as regards page numbers—that is to say, each part starts with page 1. The parts have the following respective headings:—Elements of Electricity and Magnetism; Direct Current Dynamos-Principles; Elements of Alternating Currents; Storage Batteries. Each part again has sub-headings dealing with various topics closely related to the subject title of the respective part or section, too numerous to mention in detail. The book is printed in clear type, with an index of contents and an alphabetical index.

Polyphase Currents, by A. Still, Professor of Engineering at Purdue University, Illinois; 300 pages, 7¼ x 4⅝ in., 101 illustrations. Published by the MacMillan Co., New York, and Whittaker & Co., London, England. Price $1.50 net. This is the second edition of a revised work published with the "Specialist Series." In this edition the scope and view point have not been changed. Comparatively little new matter has been introduced, but much of the original matter has been re-arranged and rewritten, and in some cases entirely omitted. The author states that an attempt has been made to present the principles underlying the operation of polyphase currents in clear and simple terms. He assumes that the reader has a fair knowledge of continuous currents but is not so familiar with alternating currents, as the application of the latter is of more recent date than continuous current systems. A non-mathematical treatment of the subject has been adopted throughout, but extensive use has been made of graphical methods. The first two or introductory chapters, have been written with the object of explaining the use of vectors in solving alternating current problems, and also for the purpose of drawing attention to the chief points of difference between alternating and continuous currents of electricity. The remaining chapters, of which there are six, deal successively with such subjects as the general principles of polyphase currents, measurement and calculation of power, polyphase transformers, power transmission by polyphase currents, polyphase induction motors and asynchronous generators and other machines. The book concludes with two appendices dealing with certain matters referred to in the text. The illustrations consist entirely of carefully drawn diagrams, consistent with the graphical method adopted throughout the work. The book will be extremely useful to the student and to those whose aim it is to become proficient in polyphase machinery. It will be valuable as an introduction to more advanced works and to a knowledge of machines and apparatus in general.

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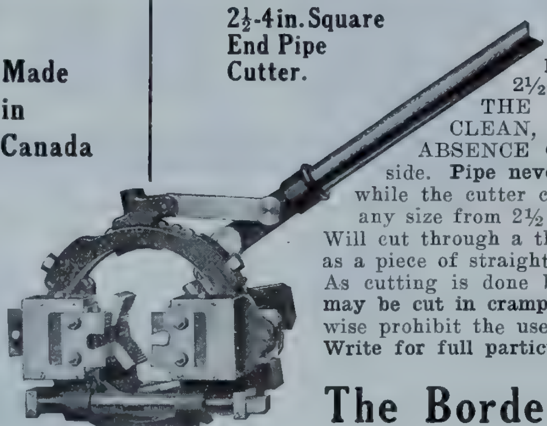

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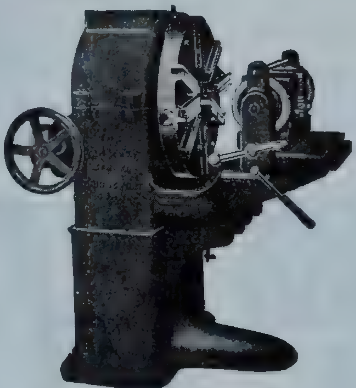

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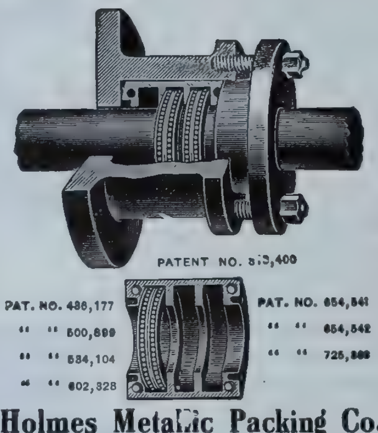
Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All coumunications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. FINLEY G. MACDIARMID,
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of
Steam Boilers.



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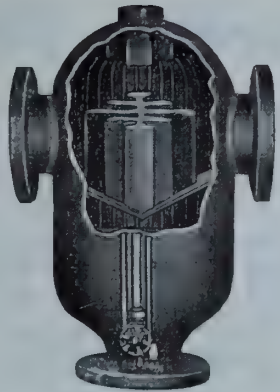

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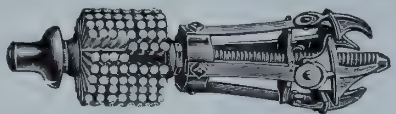

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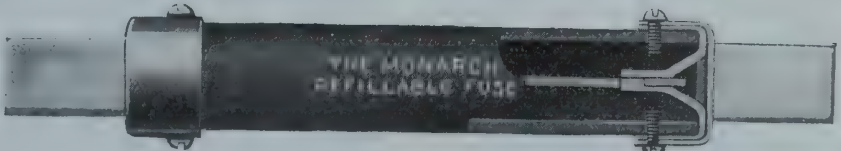

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Hawkins' Aids

This work is an important aid to engineers of all grades, and is undoubtedly the most helpful ever issued relating to a safe and sure preparation for examination. It presents in a condensed form the most approved practice in the care and management of Steam Boilers, Engines, Pumps, Electrical and Refrigerating Machines, also a few plain rules of arithmetic with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the Steam Engine and Steam Boiler.

It contains various rules, regulations and laws of large cities for the examination of boilers and the licensing of engineers.

The book gives the underlying principles of steam engineering in plain language, with very many sample questions and answers likely to be asked by the examiner.

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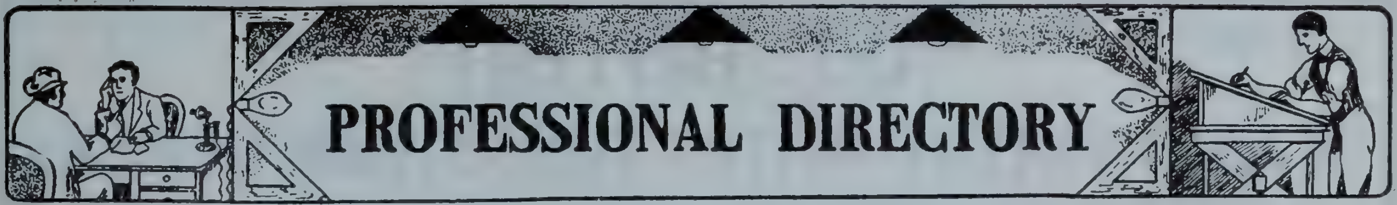

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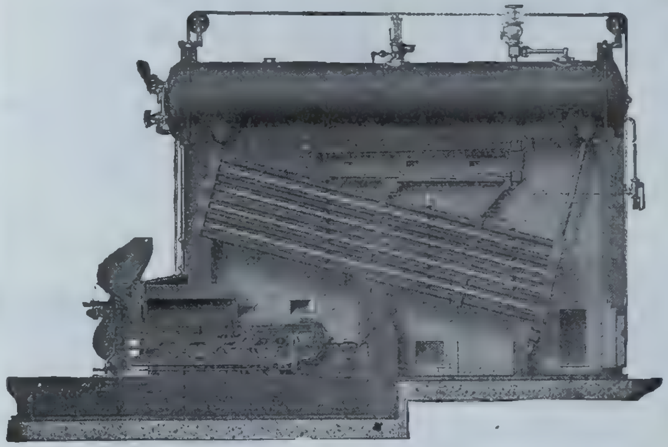

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Engines, Single, Compound and Triple Expansion.
W. H. Allen Son & Co., Bedford,
Boving & Co., of Canada, Limited, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Works, Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

Engines, Vertical.
W. H. Allen Son & Co., Bedford, Eng.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.

Engineering Books.
MacLean Publishing Co., Toronto.

Engineers' Supplies.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Lunkenheimer Co., Cincinnati, O.

Exhaust Fans.
W. H. Allen Son & Co., Bedford, Eng.
Terry Steam Turbine Co., Hartford, Conn.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.
Terry Steam Turbine Co., Hartford, Conn.
Watson & McDaniel Co., Philadelphia.

Expansion Joints.
Lunkenheimer Co., Cincinnati, O.

Fans, Ventilating.
B. F. Sturtevant Co., Boston, Mass.
Sheldons, Limited, Galt, Ont.

Feed Water Heaters.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Can. Allis-Chalmers, Ltd., Toronto.
Chaplin & Fulton Mfg. Co., Pittsburg, Pa.
Elliott Co., Pittsburgh, Pa.

Filters.
John McDougall Caledonian Iron Works, Montreal.
Siemon Co., Toronto.

Filters, Water.
Frick Co., Waynesboro, Franklin Co.
Theodore Kipp Co., Winnipeg.
Siemon Co., Toronto.

Fire Extinguishers and Fire Alarm Apparatus.
S. L. Davis Co., London, Ont.
Northern Electric Co., Ltd., Montreal.

Fire Hose.
Canadian Consolidated Rubber Co., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanged Pulleys.
American Pulley Co., Philadelphia.

Flanges.
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

Flue Blowers.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.

Flue Cleaners.
Bromell Patents Co., Glasgow, Scotland.
Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
William B. Pierce Co., Buffalo, N.Y.

Flue Gas Analysis Instruments.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Flumes, Steel.
Boving & Co., of Canada, Limited, Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Friction Leathers.
Graton & Knight Mfg. Co., Montreal.

Furnaces.
John Inglis Co., Ltd., Toronto.
Monarch Electric Co., St. Lambert.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.
Northern Electric Co., Ltd., Montreal.

Fuses, Renewable.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Economy Fuse & Mfg. Co. of Canada, Montreal.
Monarch Refillable Fuse Co., Hamilton, Ont.

Gas Analysis Instruments, Etc.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gaskets, Rubber, Asbestos, Lead Copper and Leather.
Durabla Mfg. Co., New York.
S. L. Davis Co., London, Ont.
Frick Co., Waynesboro, Franklin Co.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

Gas Producer Plants.
Boving & Co. of Canada, Limited, Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Allis-Chalmers, Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Theodore Kipp Co., Winnipeg.
E. Leonard & Sons, London, Ont.

Gasolene and Oil Storage and Distributing Systems.
S. F. Bowser & Co., Inc., Toronto.

Gauge Cocks.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Durabla Mfg. Co.. New York.
Lunkenheimer Co.. Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
W. J. Wall. Montreal.
Garlock Packing Co.. Hamilton. Ont.
Lunkenheimer Co.. Cincinnati, O.

Gauges, Ammonia, Oil, Gas, Air.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
C. A. Dunham Co., Ltd.. Toronto.
Lunkenheimer Co.. Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

Follow the Line of Least Resistance

LINE up on one side the firms who advertise. Place on the other the concerns who don't.

¶ Then invite public inspection.

¶ On which side and in whose company would you prefer to be?

¶ Or, let us place on one side well-known advertised goods and on the other side little known and unadvertised brands.

¶ And, then in the role of buying public which would *you* favor?

¶ If you read this advertisement, you have read others. Having read advertisements you must surely prefer advertised products. If you don't you are the rare exception and prove the rule.

¶ A man who favors advertised soap or food or clothing, or tobacco or pianos will naturally be prejudiced in favor of advertised Engines and Boilers, Valves and Steam Traps, Packing, Pulleys and Belting, or anything else he may require for his plant.

¶ It would be unprofitable to try to overcome that prejudice, and an act of wisdom to take advantage of it—by advertising.

¶ A great preference for advertised goods has been established in the public mind. You can't avoid it, or deny it, or profitably overlook it, or forget it.

¶ Why not follow the line of least resistance, and ADVERTISE?

THE POWER HOUSE

143-153 University Avenue - - - TORONTO, ONTARIO

Gauges, Water.
- Jenkins Bros., Ltd., Montreal.
- The Lunkenheimer Co., Cincinnati, O.
- Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Gears, Cut, Worm, Mortise.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart-Turner Machine Co., Ltd., Hamilton.

Generators and Convertors.
- W. H. Allen Son & Co., Bedford,
- Canadian Fairbanks-Morse Co., Ltd., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Northern Electric Co., Ltd., Montreal.
- Terry Steam Turbine Co., Hartford, Conn.

Gongs.
- Northern Electric Co., Ltd., Montreal.

Governors, Engine.
- Waterous Engine Works Co., Brantford, Ont.

Governors, Water Wheel.
- W. H. Allen Son & Co., Bedford,
- Can. Allis-Chalmers, Ltd., Toronto.

Graphite, Boiler.
- Commercial Oil Co., Hamilton.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.

Graphitol.
- C. C. Snowdon, Calgary.

Grates, Dumping, Rocking, Stationary.
- Babcock & Wilcox, Montreal.
- Ed. Bennis & Co., Little Hulton, Bolton, Eng.
- Canadian Steam Boiler Equipment Co., Toronto.
- Galt Foundry Co., Galt, Ont.
- Richard Thompson & Co., New York.
- Geo. H. Tod, Toronto.
- Waterous Engine Works Co., Brantford, Ont.

Grease Cups.
- Detroit Lubricator Co., Walkerville.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Grease and Oil Extractors.
- Can. Allis-Chalmers, Ltd., Toronto.
- Elliott Co., Pittsburgh, Pa.
- C. C. Snowdon, Calgary.

Greases.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Oil Companies, Ltd., Toronto.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.

Hand Leathers or Pads.
- Graton & Knight Mfg. Co., Montreal.

Hangers.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery and Transmission Co., Elmira.
- Goldie & McCulloch Co., Galt.
- Waterous Engine Works Co., Brantford.

Heaters.
- Babcock & Wilcox, Ltd., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- Goldie & McCulloch Co., Galt.
- John Inglis Co., Ltd., Toronto.
- E. S. Manny Co., Montreal.
- Theodore Kipp Co., Winnipeg.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford, Ont.

Heating Engineers.
- C. A. Dunham Co., Ltd., Toronto.
- Theodore Kipp Co., Winnipeg.

Hoists
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Hoisting and Conveying Machinery
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.
- John Inglis Co., Ltd., Toronto.
- Waterous Engine Works Co., Brantford, Ont.

Hose, Steam, Suction and Water.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- S. L. Davis Co., London, Ont.
- Garlock Packing Co., Hamilton, Ont.
- Goodyear Tire & Rubber Co., Toronto.
- Quaker City Rubber Co., Philadelphia, Pa.

Hydraulic Accumulators.
- Can. Allis-Chalmers, Ltd., Toronto.
- Smart-Turner Machine Co., Ltd., Hamilton.

Hydraulic Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- John Inglis Co., Ltd., Toronto.
- John McDougall Caledonian Iron Works, Montreal.

Hydraulic Presses.
- Bawden Machine Co., Toronto.

Ice Making Machinery.
- Arctic Ice Machine Co., Canton, Ohio.
- Can. De La Vergne Co., Limited. Montreal.
- Frick Co., Waynesboro, Franklin Co.
- Linde Canadian Refrigeration Co., Montreal.
- John Inglis Co., Ltd., Toronto.
- York Mfg. Co., York. Pa.

Insulators.
- Ed. Bennis & Co., Little Hulton. Bolton, Eng.
- Geo. H. Tod, Toronto.
- Northern Electric Co., Ltd., Montreal.

Indicators Electric—All Types.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
- Richard Thompson & Co., New York.

Indicators, Steam and Gas Engine.
- Can. Fairbanks-Morse Co., Montreal.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Richard Thompson & Co., New York.

Indicators—Ammonia, Hydraulic.
- Can. Detroit Lubricator Co., Walkerville, Ont.

Injectors.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Penberthy Injector Co., Windsor.

Instruments.
- Northern Electric Co., Ltd., Montreal.

Iron Filler.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- S. L. Davis Co., London, Ont.

Journal Greases.
- Commercial Oil Co., Hamilton.

Lace Leathers.
- Graton & Knight Mfg. Co., Montreal.

Lamps, Tungsten, etc.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Sunbeam Lamp Co., Toronto.
- S. L. Davis Co., London, Ont.
- Northern Electric Co., Ltd., Montreal.

Lamps, Arc, Incandescent.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian Westinghouse Co., Hamilton
- Northern Electric Co., Ltd., Montreal.

Leather Strapping.
- Graton & Knight Mfg. Co., Montreal.

Lubricants.
- Can. Oil Companies, Ltd., Toronto.
- Jos. Dixon Crucible Co., Jersey City.
- C. C. Snowdon, Calgary.
- Commercial Oil Co., Hamilton.

Lubricators, Force Feed.
- C. A. Dunham Co., Ltd., Toronto.
- Darling Bros., Montreal.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.
- Peterborough Machine & Lubricator Co., Ltd., Peterborough.

Lubricators, Plain.
- C. A. Dunham Co., Ltd., Toronto.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.

Magnet and Trolley Wires.
- Northern Electric Co., Ltd., Montreal.

Magnets, Lifting, Generators.
- Terry Steam Turbine Co., Hartford, Conn.

Magnetos.
- Northern Electric Co., Ltd., Montreal.

Mechanical Stokers.
- Babcock & Wilcox, Montreal.
- Ed. Bennis & Co., Little Hulton, Bolton, Eng.
- Jones Underfeed Stoker Co., Toronto.
- Murphy Iron Works, Detroit, Mich.
- Geo. H. Tod, Toronto.

Measuring Instruments.
- Northern Electric Co., Ltd., Montreal.

Metal Spools.
- American Pulley Co., Philadelphia.

Meters, Electric.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Canadian General Electric Co., Ltd., Toronto.
- Canadian Westinghouse Co., Hamilton.

Meters, Water.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

Mica.
- Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
- W. H. Allen Son & Co., Bedford.
- Can. Fairbanks-Morse Co., Montreal.
- Jenckes Machine Co., Sherbrooke, Que
- Goldie & McCulloch Co., Galt.
- Theodore Kipp Co., Winnipeg.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.
- Can. Allis-Chalmers, Ltd., Toronto.

Molds, Rubber.
- Bawden Machine Co., Toronto.

Motors.
- W. H. Allen Son & Co., Bedford.
- Can. Fairbanks-Morse Co., Montreal.
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- S. L. Davis Co., London, Ont.

Motor Starters and Controllers.
- W. H. Allen Son & Co., Bedford, Eng
- Canadian General Electric Co., Ltd., Toronto.
- Can. Westinghouse Co., Hamilton.
- Terry Steam Turbine Co., Hartford, Conn.

Office Railings.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
- Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
- Can. Detroit Lubricator Co., Walkerville, Ont.
- Lunkenheimer Co., Cincinnati, O.

Oil Filters & Circulating Systems.
- S. F. Bowser & Co., Inc., Toronto.
- Darling Bros., Montreal.
- Elliott Co., Pittsburgh, Pa.
- Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators.
- Babcock & Wilcox, Montreal.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- Elliott Co., Pittsburgh, Pa.
- Liberty Mfg. Co., Pittsburg.
- Jas. Morrison Brass Mfg. Co., Toronto.
- Smart - Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
- S. F. Bowser & Co., Inc., Toronto.
- Theodore Kipp Co., Winnipeg.
- Lunkenheimer Co., Cincinnati, O.

Oils, Lubricating.
- Can. Oil Companies, Ltd., Toronto.
- C. C. Snowdon, Calgary.

Packing, Engine.
- Can. H. W. Johns-Manville Co., Toronto.
- Goodyear Tire & Rubber Co., Toronto.
- S. L. Davis Co., London, Ont.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Hydraulic.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Goodyear Tire & Rubber Co., Toronto.
- Greene, Tweed & Co., New York.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Metallic.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- Holmes Metallic Packing Co., Wilkesbarre, Pa.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
- Goetze-Gasket & Packing Co., New Brunswick, N.J.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Garlock Packing Co., Hamilton, Can.
- Goodyear Tire & Rubber Co., Toronto.
- Steel Mill Packing Co., Windsor, Ont.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Sheet.
- Canadian Consolidated Rubber Co., Ltd., Montreal.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Goodyear Tire & Rubber Co., Toronto.
- Jenkins Bros., Ltd., Montreal.
- Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
- Canadian H. W. Johns-Manville Co., Toronto.
- S. L. Davis Co., London, Ont.
- Durabla Mfg. Co., New York.
- Garlock Packing Co., Hamilton, Can.
- Goodyear Tire & Rubber Co., Toronto.
- Greene, Tweed & Co., New York.
- Pilley Packing & Flue Brush Mfg. Co., St. Louis, Mo.
- Quaker City Rubber Co., Philadelphia, Pa.
- Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
- Graton & Knight Mfg. Co., Montreal.

Packing Rings.
- Lake Erie Mfg. Co., Inc., Buffalo, N.Y.

Patents.
- Rowland Brittain, Vancouver, B.C.

Penstocks.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.

Pillow Blocks.
- Can. Bond Hanger & Coupling Co., Alexandria.
- Elmira Machinery & Transmission Co., Elmira, Ont.
- Waterous Engine Works Co., Brantford, Ont.

Pipe Coils.
- York Mfg. Co., York, Pa.

Pipe Coverings.
- S. L. Davis Co., London, Ont.

Pipe Fittings.
- International Malleable Iron Co., Guelph.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
- Oster Mfg. Co., Cleveland, O.

Pipe Steel.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- E. Leonard & Sons, London, Ont.

Pipes, Water.
- Aiton & Co., Ltd., Derby.
- Can. Allis-Chalmers, Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Pacific Coast Pipe Co., Vancouver.

Piping and Fittings.
- Frick Co., Waynesboro, Franklin Co. Pa.
- International Malleable Iron Co., Guelph.
- Lunkenheimer Co., Cincinnati, O.
- Jas. Morrison Brass Mfg. Co., Toronto.
- York Mfg. Co., York, Pa.

Piping, Steam.
- Babcock & Wilcox, Montreal.
- Imperial Waste & Metal Co., Montreal.

Planimeters.
- Richard Thompson & Co., Toronto.

Plate Work.
- Can. Allis-Chalmers, Ltd., Toronto.
- Goldie & McCulloch Co., Galt.
- Jenckes Machine Co., Sherbrooke, Que.
- Waterous Engine Works Co., Brantford.

Pneumatic Chain Blocks.
- Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Polish, Metal.
- Can. H. W. Johns-Manville Co., Ltd., Toronto.
- G. W. Hoffman, Indianapolis.

Power Pumps.
- American Steam Pump Co., Battle Creek, Mich.
- W. H. Allen Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Boving & Co., of Canada, Limited, Toronto.
- Can. Fairbanks-Morse Co., Montreal.
- Can. Allis-Chalmers, Ltd., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Ltd., Toronto.
- Goldie & McCulloch Co., Galt.
- E. Leonard & Sons, London, Ont.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Waterous Engine Works Co., Brantford.
- Canadian H. W. Johns-Manville Co., Ltd., Toronto.
- Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
- American Pulley Co., Philadelphia.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery & Transmission Co., Elmira, Ont.
- Goldie & McCulloch Co., Galt.
- Jeffrey Manufacturing Co., Columbus.
- Jenckes Machine Co., Sherbrooke,
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Waterous Engine Works Co., Brantford.

Presses.
- Bawden Machine Co., Toronto.
- John Inglis Co., Ltd., Toronto.

Pulleys.
- American Pulley Co., Philadelphia.
- Can. Fairbanks-Morse Co., Montreal.
- Elmira Machinery and Transmission Co., Elmira, Ont.
- Jeffrey Manufacturing Co., Columbus.
- Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
- W. H. Allen Son & Co., Bedford, Eng.
- The Bawden Machine Co., Toronto.
- Escher, Wyss & Co., Toronto.
- Jeffrey Manufacturing Co., Columbus.
- E. Leonard & Sons, London, Ont.
- Waterous Engine Works Co., Brantford.

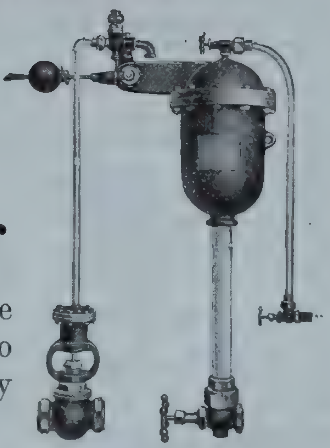
Pump Leathers.
- Graton & Knight Mfg. Co., Montreal.

Pumping Machinery.
- American Steam Pump Co., Battle Creek, Mich.
- Boving & Co., of Canada, Limited, Toronto.
- John Inglis Co., Ltd., Toronto.
- Bawden Machine Co., Ltd., Toronto
- Can. Allis-Chalmers, Ltd., Toronto.
- The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
- Smart - Turner Machine Co., Ltd., Hamilton.
- Terry Steam Turbine Co., Hartford, Conn.
- Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
- W. H. Allen, Son & Co., Bedford, Eng.
- Bawden Machine Co., Ltd., Toronto.
- Jeffrey Manufacturing Co., Columbus.
- Terry Steam Turbine Co., Hartford, Conn.

Pump Governors and Regulators.
- Bawden Machine Co., Toronto.
- Canadian Steam Boiler Equipment Co., Toronto.
- Darling Bros., Montreal.
- C. A. Dunham Co., Toronto.
- G. M. Davis Regulator Co., Chicago,

The VIGILANT Feed Water Regulator



has earned its title and is living up to its reputation every day.

STUFFING BOX ANNOYANCES

are unknown in the Vigilant Feed Water Heater, because there is never any pressure on any stuffing box. Pressure on stuffing boxes is a constant source of trouble and annoyance. Such features in the design of the Vigilant make the most satisfactory feed water regulator on the market.

Write for Catalogue.

The Chaplin-Fulton Mfg. Company
28-34 Penn Ave., Pittsburgh, Pa.

Sole Agents for Province of Quebec:
R. E. Cleaton Co., 20 St. Nicholas Street, Montreal

Where Oil Efficiency Spells Dollars

Used by Westinghouse Electrical & Mfg. Co., Pittsburg, Pa.

When concerns like the Indiana Steel Co., National Cash Register Co., Singer Mfg. Co., Westinghouse Electrical & Mfg. Co., etc., use the Bowser Systems for safe, convenient and economical handling of lubricants, paint oils, varnishes, etc., it is because they are **Money Savers.**

BOWSER ESTABLISHED 1885 **Safe Oil Storage Systems**

Oil Saving Will Surprise You

The Bowser System insures you as near 100% oil efficiency as you'll ever get. It gives the oil unfailingly. It catches it all again and returns it to the most efficient clarifying device ever made. No oil is wasted—no deterioration—quantity is reduced but slightly—**you will order fewer barrels per year**—and you know how much a barrel costs.

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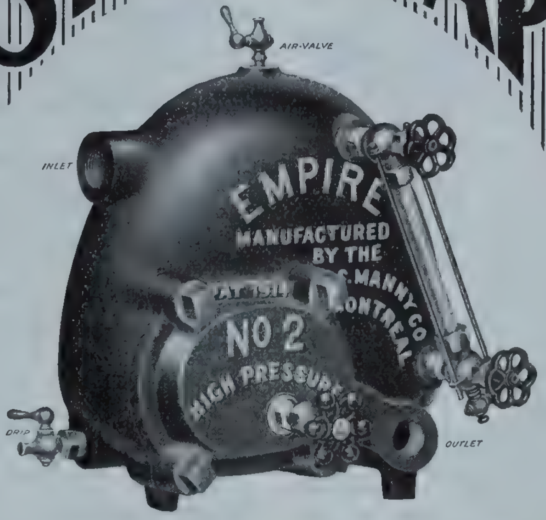
Get the Free Bowser Book **Now.** Ask us your oil questions. No obligation involved. It may mean a new day in the efficiency and economy of your plant operation.

S. F. Bowser & Co., 330 Frazer Avenue, Toronto, Ont., Can.

Sales Offices in all Centers and Representatives Everywhere

EMPIRE STEAM TRAP



Valve Area is Increased and Capacity Nearly Doubled by Means of

a counterbalance lever, which also increases its sensitive action in discharging the water.

CONTINUOUS IN OPERATION

No screws to adjust for different pressures **Requires no attention.**

No stuffing boxes to prevent the free working of the lever.

The "Empire" has a **plug valve,** made of phosphor bronze, that will not stick or become clogged with dirt.

Copper Floats are seamless, made by a new process and cannot be collapsed.

We know by experience that these are the **cheapest,** the **most reliable** and **perfect working** traps ever made.

A TRIAL WILL CONVINCE **YOU.**

Working parts are all bronze and non-corrosive.

Good for either high or low pressure. Guaranteed to satisfy.

Manufactured by

The E. S. MANNY CO.
MONTREAL, CANADA
REPRESENTATIVES WANTED

Elliott Co., Pittsburgh, Pa.
Smart - Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Bawden Machine Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
C. A. Dunham Co., Ltd., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
W. H. Allen Son & Co., Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Contractors'.
W. H. Allen Son & Co., Bedford, Eng.
Bawden Machine Co., Toronto.
William Hamilton Co., Ltd., Peterborough.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Hand and Power.
S. F. Bowser & Co., Inc., Toronto.

Pumps, Centrifugal.
Boving & Co., of Canada, Limited, Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Bromell Patents Co., Ltd., Glasgow, Scotland.
John Inglis Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Works, Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Theodore Kipp Co., Winnipeg.
Terry Steam Turbine Co., Hartford, Conn.
Turbine Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Allis-Chalmers, Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
John Inglis Co., Ltd., Toronto.
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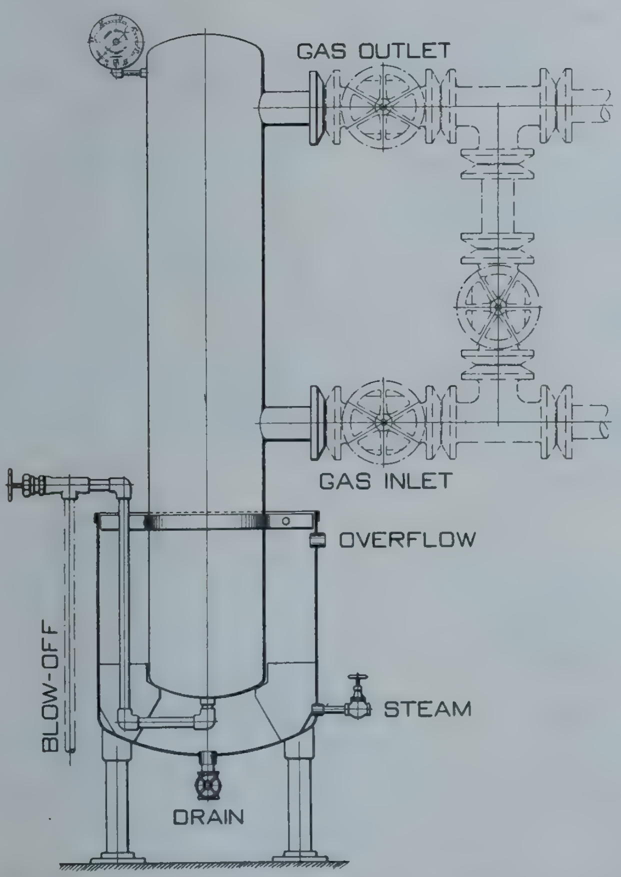

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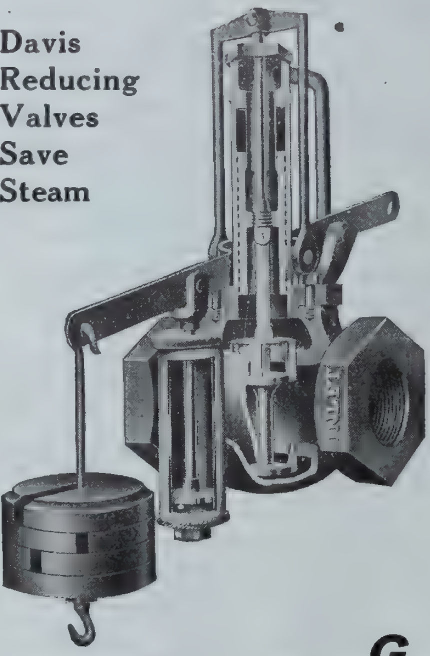

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